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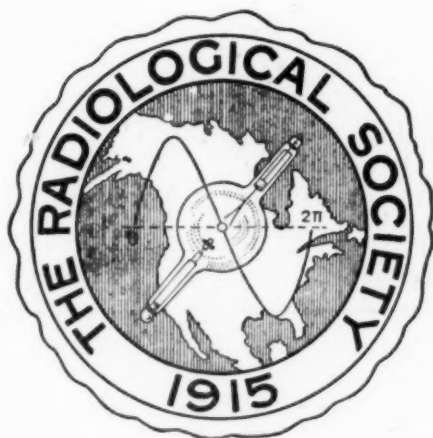
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# THE JOURNAL OF RADIOLOGY

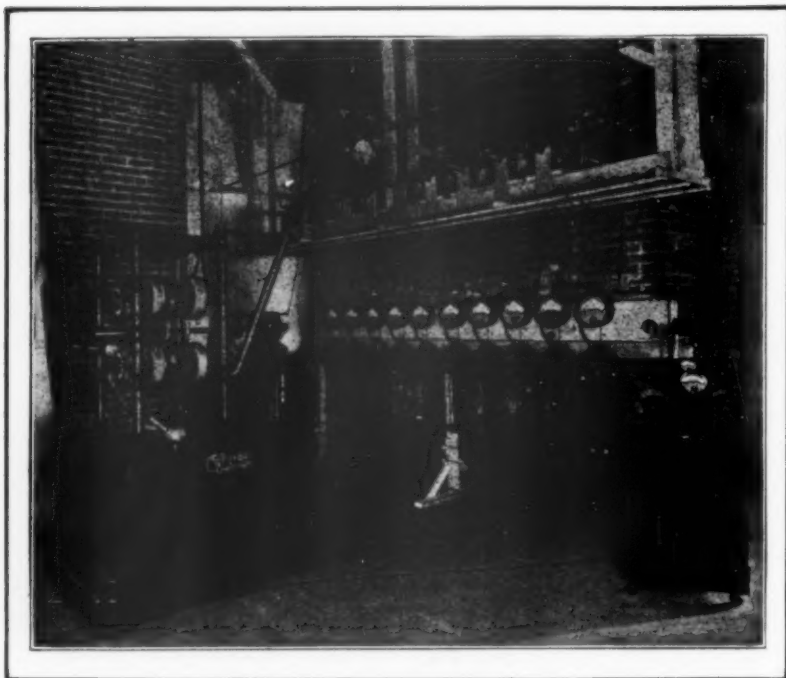
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## PROOF BY PERFORMANCE

### The "Snook-Special" Deep Therapy Diagnostic Machine Proves Up Under Supreme Test

THE design of the "Snook-Special" Deep Therapy Diagnostic Machine was to provide for not only the present 200,000-volt Coolidge tube of 8 milliamperes capacity, but also in view of future Coolidge tube developments calling for higher milliamperes at this voltage.

It was desired that when offering the "Snook-Special" to the Roentgenologist a definite statement regarding its capacity could be made, substantiated by records of actual performance.

To conduct a test under conditions which would be practically equivalent to those which would prevail were a 30 M. A. Coolidge Tube available, Victor engineers connected in parallel ten deep therapy Coolidge tubes of the present type, each with a separate Victor-Kearsley Stabilizer and filament trans-

former, thus providing means for control of current in each tube, independent of the others. With the "Snook-Special" delivering 30 milliamperes of current, these tubes are energized simultaneously, at an average of 3 M. A. in each tube.

This set-up has been running almost daily for some months past in our factory experimental department, and has furnished conclusive proof of its operating ability to many visiting Roentgenologists.

This demonstration is for the purpose of proving machine capacity and performance under conditions more difficult and exacting than any X-ray machine has ever been called on to meet. This is not intended as a demonstration of the feasibility of running tubes in multiple.

A bulletin containing complete description of  
the "Snook-Special" will be sent on request

**VICTOR X-RAY CORPORATION**, Jackson Blvd. at Robey St., Chicago  
*Sales Offices and Service Stations in All Principal Cities*



# The JOURNAL OF RADIOLOGY

## Omaha, Nebraska

VOL. IV

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### The Cause of the Action of X-Rays and Gamma Rays of Radium Upon Living Cells\*

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THE CONTEMPLATION of histological sections, and even more remarkable, the macroscopic study of irradiated areas shows the profound effect of the influence of x-rays upon living cells. This enormous effect which may easily lead to complete necrosis of extensive areas strikes one more forcibly when the total amount of energy producing it is taken into consideration.

We can easily calculate the energy of x-rays which is absorbed by the body. For instance, the electrical energy consumed in a Coolidge tube delivering five milliamperes at 200 kv. in one second is  $5.10^{-3} \cdot 2.10^5$  watt seconds =  $1.10^3$  watt second = 1 kilowatt second. The efficiency of the transformation of electrical energy into roentgen rays is about 1:1000. Therefore, the body receives about 1 watt second = 0.24 gram calories of radiation under the above mentioned conditions. A field of entry of about 100 cm.<sup>2</sup> and 40 cm. target skin distance will receive about 1/200 part of the rays generated. Now, if half of the rays striking the field of entry are absorbed in the body this is equivalent to 1/400 of the rays produced. This in turn is equivalent to 1/400 of 0.24 gram calories as measured in heat units,

0.24

namely:  $\frac{0.24}{400}$  gram calories. Given a

tube running fifty minutes under these conditions, the total amount of x-ray energy absorbed in the body is equivalent to (50 min. = 3000 sec.)  $0.24 \times 3000$

400

gr. cal. or 1.8 gr. cal.

\*—Read by Ernst A. Pohle, M.D., Assistant of the Institute, at the Annual Meeting of the Radiological Society of North America, Detroit, Dec. 5, 1922. Dr. Pohle wishes to thank Dr. N. Moore of Grand Rapids and Dr. Georges Thomas of Cleveland, who kindly assisted in the translation of this article.

or in even numbers 2 gr. cal. In other words, that is the amount of energy that will raise the temperature of two grams of water or of human tissue 1° centigrade. Hence, it is apparent that a hot compress or a swallow of hot water will give to the human body much more of the same energy than this energy of x-rays. But it is well known that this quantity of x-rays is capable of producing severe necrosis of cells and even the death of a human being. From this it may be deduced, that x-rays are indeed a very unusual therapeutic agent, and that the cells are profoundly in-



Professor Friedrich Dessauer, Ph.D. Frankfurt am Main, Germany, whose work made deep roentgen ray therapy possible.

fluenced when the high frequency waves of x-rays are passing through them. During radiation the cells are placed in quickly oscillating electric and magnetic fields at points where electric and magnetic forces are produced, disappearing and changing in direction, for that is the description of oscillations in a hitherto neutral place. The great problem which still remains un-

solved today is as follows: What is the effect of the frequency  $V$  of the pulsating field upon the cells? The nature of the energy produced by the x-ray tube and striking the body is well known. We also know of the histological changes which such energy produces. But how the one effects the other, is still a matter of great uncertainty. Very often this question has been asked, and very often attempts have been made to solve it by biological methods of research. The activation and destruction of ferments, the exhausting of albumin and lecithin, the influence of internal secretion upon the blood and blood-forming organs and many other things have been thought of and considered as possible explanations of it. Lately the stimulating effects which are produced by relatively small doses have rightly attracted the attention of the biological workers. They touch the problem of the general systemic effect of radiation upon the body as a whole. It is a biological fact that all cells are effected by radiation, but in very different degrees. The laws governing these effects have been given by Hertwig-Bergonie and Tribondeau, viz: the young undifferentiated fast growing cells are more sensitive to x-rays than adult tissue, but not as formerly stated, the cells having active metabolism.

On the other hand, we have some idea of the transformation which occurs during the absorption of x-rays in gases. We can follow this process especially through the splendid and well-known experiments of C. T. R. Wilson. Many a thing is known in this regard, even quantitatively. The absorbed x-rays liberate electrons, in the kinetic energy of which—according to the newest explanation—all the energy of the x-rays is completely recovered. These electrons are repeatedly caused to deviate and travel in a zig-zag course through the gas, forming, step by step, gas-ions which form nuclei of condensation and are, therefore, easily seen in the photos of Wilson. In these experiments there



are formed drops of water that can be very brightly illuminated by a flash and therewith photographed and thus show the position of thousands of ions and in this way the path of electrons. The pictures have been given so many times in different publications and shown in lectures that I do not think it necessary to reproduce them here.

The electron when forming an ion loses a part of its energy and, therefore, its velocity gradually diminishes and finally the electron comes to rest. The ions can exist in a closed space a long time, but finally they combine with each other. As the end result of the transformation, a small gain in the kinetic energy of the gas molecules will be recorded, identical with a slight rise in the temperature.

Experimentally, it has not been possible to prove that the disintegration of the x-rays in tissue takes place in a similar manner with the formation of electrons (with the kinetic energy equal to absorbed x-rays), in the first step, with the formation of ions (with a number and distribution of ions depending upon the kinetic energy of electrons) in the second step, and in the third step, by collisions during ionization and by recombination. But in any case, the final result must be heat. There is no doubt that in a very short time after the absorption of the x-rays, the energy has changed into heat. Between the first and last step we must look for the biological effect.

The proof of the disintegration of high frequency rays through electrotransformation into heat is well seen by the so-called "photo effect." Light rays striking the surface of many materials, particularly those of alkali metals cause them to emit electrons and cause the metals to become positively charged. The field stress of the incident rays gives the electrons sufficient impulse to enable them to leave the surface of, for instance, a piece of potassium. Generally, this effect upon liquid surfaces is very small; water shows very little emission, whereas, ice gives three hundred times as much and with shorter waves even more. The presence of a very fine colloidal skin upon color solution produces this otherwise absent effect. The electrolytic character of a liquid has no influence upon this property, although the experiments made by Swenson with salt solution seem to show positive results.

This photo-electric effect of Hallwachs takes place in every case where the rays strike solid bodies: electrons with remarkable initial velocity are emitted into space and, therefore, can be observed. So it appears that the absorption of rays is accompanied by the emission of electrons and thereby all

the energy of the absorbed waves

$$(h \times v = e \times V = \frac{mv^2}{2}) \text{ is completely}$$

retained. This is shown by reference to Einstein's and Planck's law and was proved by many experiments in the "volt velocity" of the electrons (of course in their kinetic energy too).

Biological experiments made by Caspari and Aschkinnass and Halberstaedter, speak for the theory that the effect of the x-rays is due to the formation of electrons. Cultures of bacteria have very high resistance to x-rays and perish only after very prolonged irradiation. Yet the effect of the rays may be greatly changed if the experiment is so arranged that the rays are transformed into the motion of electrons and the electrons strike the culture. That is a very simple experiment. It is so arranged that the x-rays penetrate from below through the bottom of a Petri glass. Immediately above the culture, a plate of high atomic metal is placed in such a manner that the lower surface is struck by the x-rays (Halberstaedter's experiment). The culture is now quickly destroyed, the destruction is caused by the electrons that are going down from the plate and correspond to the form of the metal plate. That this effect is not due to secondary x-rays is proved when there is interposed a thin piece of paper which is almost non-transparent for electrons and quite transparent for the x-rays. It seems that the small effect of the x-rays on the culture in the experiment without a piece of metal may also be caused by the electrons and that it is so very small because so very few secondary electrons are produced in the culture in comparison with the number of electrons emitted from the metal of high atomic weight.

Yet it must not be concluded that there is a relation between the action upon the cells and their contents of heavy elements such as iron, calcium, etc., for no trace of such a relative sensibility has been proved. The difference in sensitiveness of rays does not seem to be based upon such primitive actions but to be purely biological.

I will give some other biological observations before I return to the physical side of the problem. Plant seeds in a good dry condition are not sensitive to roentgen rays even when they are very heavily irradiated. But when moistened they begin to germinate and become very sensitive. This effect may be ascribed to the influence of water, but it may also be due to the stage of germination. Organs, skin for instance, kept alive in vitro, are very much less sensitive than in vivo. These facts do not appear to offer an explanation of

any kind, but we shall soon see that they admit certain physical inference.

Then physically it is probable that the connection between the absorbed wave energy of x-rays in tissue and the biological result is through the electrons. The experiment with the culture of bacteria and the strip of metal could be duplicated in the living body producing, however, only a very superficial effect. The intense effect of the beta and cathode rays upon the skin prove it (Caspari, Aschkinnass, Strebel). Then the above considerations admit that the secondary electrons generated by x-rays (they are often named "secondary cathode rays or beta rays" as they are also electrons in motion) are the substantial cause of the biological effects and that x-rays may be accepted as exciters of this kind of energy (the velocity, length of path) and distributors of the energy which may differ widely according to the quality of the rays. In another place, I have shown that the difference in the distribution using soft or hard rays may be about 1:30000.

What is the action of the electrons in the human body? In gases they are ionizing, but are they in the human body?

Physically, the human body may be regarded as a system of electrolytes, colloids and membranes. This affords sufficient possibilities. After conversation with Professor Friedrich Kraus of the second medical clinic in Berlin, with Prof. Caspari and my friend and coworker, Dr. R. E. Liesegang, experiments in my institution have been made, mostly by Dr. Janitzky, to discover any effects or disturbances, due to ionization during the absorption of x-rays. Previously, Friedrich and Schwarz studied the effects of catalyzers.

The final results of the experiments are at present unfinished, but their results will be published later. It is energetically quite possible to prove that ionization changes the conduction in an electrolyte even if only a very small fraction of the energy of the electrons is transformed into provable ionization. But the question arises: can the ionization due to absorbed x-rays be found at all in an electrolyte? That is easily made clear through a calculation. The experiments in gases show that the ions have received sufficient velocity to move away from each other. They cannot recombine as the electrostatic forces decrease with the square of the distance. The result is the ionization of the gas which is the basis for electroscopic and ionization measurements. Considering, in the first place, that the length of path of the ions is reduced with the density of the media, their



paths in the electrolytes would be reduced a thousandfold more than in air. The Coulomb force of re-attraction would be as the square of the path travelled, in this case 1,000,000 times greater than in gas, but owing to the di-electrical constant being 80 times higher, therefore, the result would be only about 10,000 times larger, assuming that the initial velocity (measured in volts) is the same as in air. With less velocity, the re-attraction would be still greater. At all events, from the consideration of this subject, it is clear that in an electrolyte the possibility of an electron travelling so far that it is not again recombined, is 10,000 times smaller than in gases. It is highly improbable that there can be found such a change in conductivity of the electrolyte due to ionization and that the biological effect could be produced by ionization, when the body is regarded as an ordinary electrolyte.

Then I had the idea of preventing the recombination of the ions by adding highly dispersed colloid in such a manner that a colloid particle should be at once interposed between the separated ions. Such and many other experiments to ascertain the difference in result from rays of different wave lengths, the influence of membranes, the reflection of electrons in the Halberstaedter experiment, and the addition of different material produce an interesting effect. But it is very improbable that this effect, which is extremely small, can produce such enormous changes in cells. Results up to the present do not prove that the process of x-ray transformation is through the electrolytic changes in tissue by means of electrons and stable ionization. The ions are speedily recombined. One must not expect large disturbances in conductivity or in the condition of the membranes. Also, the changes of catalyzing processes under radiation observed by Friedrich and Schwarz are very small. Before I give any other theory which serves me now as a working hypothesis, it is well to mention the photo-effects of x-rays. These latter also are, on the average much smaller than in the absorption of visible light. It is altogether impossible to explain with the photo effect the profound influence of x-rays upon the surface or the deep parts of the human body.

A possible explanation that I have in mind and that is supported by a number of observations is based on the fact that the formation and recombination of ions by the absorption of x-rays must be combined with kinetic effects. The impulse which reaches the cell molecules is considerable (both for the molecules first bombarded and for those afterwards struck). These im-

pacts, the sum total of which is a large amount of kinetic energy in a very small space, may be regarded as a considerable rise of temperature in this very small space, which has to take place because the consequent dispersion of the heat at sinking temperature will naturally require a certain lapse of time. Undoubtedly the whole of the absorbed energy of the rays is converted into heat, that is, kinetic energy of the particles of the heated space. The total heat produced, as previously calculated, is exceedingly small, but heat is regarded as distributed over all the molecules of the heated space. The active effect is at every moment confined to very few molecules and groups of molecules. Concerning the heat, I would like to speak about "point-heat" which signifies a very high rise of temperature that suddenly comes into a molecule and into the adjacent cells. For example, a micro-observer who would see the molecules like dust particles in sunlight would observe them glowing up everywhere interspersed between millions of indifferent molecules and zigzagging in all directions as in the Wilson photos. Similar explanations have been offered physically of the impact of alpha-particles and beta-rays of which the kinetic energies and the "temperatures" of course are still higher. There are many analogies for such "concentrations" of energy before its diffusing. Professors Cermak, Giessen, mentioned in a conversation as an example, a lake into which small meteors might fall. The kinetic energy of the meteor-stone which raises the temperature of the lake and disturbs its level but slightly, is at the first moment very remarkable, because locally concentrated. The water spouts out a meter high, whereby a sensitive object near this spot may readily be destroyed.

Sensitive undifferentiated cells undergoing mitosis, will be damaged, when such "point-heat" is developed in their nuclei. Growing processes are very sensitive to heat and cold. Tissue living in vitro has a few numbers of cells undergoing kariokinetic change. As yet there are no forceful arguments in favor of my view, but the fact of such a localized concentration of energy in the time of its reforming into heat is absolutely certain, while the process of a definite extensive considerable electrolytic change, is very improbable. As far as I know, no satisfactory experiment has been conducted about the relationship of the electrolytical nature to the sensitiveness of rays. The two following ideas seem to me to be especially important for my theory. The "point-heat" effect is limited to points at which the electron loses a part of its kinetic energy by

impact. A chain of points, very much closer to each other than the gas particles of Wilson's experiments will be produced. If at these points are situated sensitive cells, especially nuclei, in critical states which cannot endure the temperature impacts upon a part of their molecules, they will suffer. If they have a higher resistance, such as muscle cells, they will be able to resist. Therefore, the sensitiveness is not a physical but a purely biological quality, as borne out by experience. It is of no account that red blood corpuscles contain iron and have, therefore, high absorption capacity, but it is only important if they are able to withstand the impact of the "point-heat." The white blood corpuscles are sensitive purely for biological reasons.

The other argument is the following: If the above theory is correct, the particles struck will be distributed very irregularly throughout the irradiated zone, according to the laws of probability. If we think about cells of one type that ought to be influenced (carcinoma cells, for instance) and for the purpose of simplifying the problem, we assume equal biological sensitiveness, distributed evenly in the irradiated zone, it is then easy to imagine that during sustained radiation the number of carcinoma cells affected will increase. Very soon many of them will be struck for the second and third and multiple times, whereas others have not yet received the first impact. The number of carcinoma cells not struck once will decrease as radiation proceeds, but the rate of decrease becomes slower and slower, whereas, the number of cells struck a number of times, will increase. Necessarily, after a prolonged radiation the following will have taken place: most of the carcinoma cells will have been struck several times, others a hundred or a thousand times, when the average effect has been obtained with the treatment, yet a few cells must remain which have not been struck once.

These facts can hardly be explained by the conception of "absorption of waves" in the sense of classical physics or by electrolytical changes. But the consequence of the "point-heat" theory, that after sufficient irradiation of practically similar cells of nearly equal sensitiveness the majority have been destroyed, and many others severely damaged and others have not been influenced, is proved by experience. Their number is reduced with prolonged overdosage, but the unaffected cells do not disappear altogether and careful experiments have frequently shown this very surprising fact. Besides the experiments and notes of Caspari (the biological foundations of deep therapy) I might mention the work of Dr. Wood, who found in a great number of ani-

mals a somewhat exponential diminution of inoculating neoplasm cells with the increase of irradiation dosage.

The question that interests us mostly and that can be sometimes controlled (biologically, for instance, by means of counting such as is done with blood corpuscles or photographically by means of blackening—measuring, analogical to discolorations, changes in viscosity, etc.) is the question as to the state of the particles in unit volume after any definite time of the radiation.

In such a unit volume (1 c.c.) between other particles of a certain known and similar sensitiveness there can be, for instance  $M$  carcinoma cells. In comparison with the space of initial action of the point-heat which we consider acts upon small molecule groups, a cell will generally be very big. According to its sensitiveness it will endure one or a greater number of impacts before it will sensibly suffer in its life (albumen coagulation, analogical to infection-like reduction of halogen silver starting from one or several points).

A single x-ray at its disintegration is able, as shown by calculation, to produce thousands of such point-heats. We will designate by  $M_r$  the number of those particles that after a given observation time generally have not suffered any influence, by  $o$  a "radiation coefficient" which depends chiefly upon the clearness and kind of light, also probably upon the size and disposition of cells; then this rest of unstruck cells is

$$M_r = M_0 e^{-oT} \quad (1st)$$

where  $e$  is the base of natural logarithms.

This signifies that with progressing radiation the number of these rest-cells will decrease at first quickly and afterwards more and more slowly.

In the same time  $T$  a great number of the cells struck only once will be struck the second time, any of those struck twice will be struck the third time, etc. Finally, the cells struck  $n$  times, will be struck  $n/l$  times. In practice, it is important to know the number of impacts which result in the destruction of the cell (the plain blackening of halogen-silver, etc.) The following impacts have no such importance, nor any other action.

If the particles struck at all (at least once, and between these, such as are struck 2, 3, . . .  $n$  and  $n \times l$  times) are marked with  $M^1$ , then it follows:

$$M_1 = M_0 (1 - e^{-oT}) \quad (2nd)$$

The particles struck twice and more would be called  $M_2$ , those struck thrice and many more times would be called  $M_3$  etc. to  $M_n$ . Each time there remains a residue. As  $M_r$  signifies the

number of particles never struck, the number of such particles which now after the time,  $T$ , are struck only once must be  $M_{r,1}$ .

If any certain time is considered, then in the next following moment the number of particles struck only once will be changed. This number will be increased by the number of particles that in this infinitely short time come from the number  $M_{r,2-1}$  and will be decreased by those which fall away owing to the following point-heats from the order  $M_{r,2}$ . The treatment leads to an integral that is equal to radioactive transformation products with equal destruction-constants. In the case that there was no influence in the time  $O$  the result for the particles is as follows:

$$M_{r,1} = M_0 o T e^{-oT} \quad (3rd)$$

Generally for the  $M_{r,a}$  particles, that is, those that have been struck only  $a$  times:

$$M_{r,a} = M_0 e^{-oT} \cdot \frac{(oT)^a}{a!} \quad (4th)$$

In the direction of these calculations lies the possibility of quantitative determination of influences, as well as the outlook for radiation, if in a given case something is known about the distribution (through counting) of the cells. Then it will be possible to find out whether the radiation is permissible or not, according to the mixture with normal cells of less sensitiveness of which not more than a definite percentage may be injured, without menacing the body.

The physical meaning of the irradiation—coefficient ( $o$ ) of point-heats.

From the general equation—

$$M_r = M_0 e^{-oT} \quad (1st)$$

where  $M_r$  is the number of the residual particles, particles not yet struck in the time,  $T$ , and  $M_0$  is the number of all particles, then

$$\frac{dM_r}{dT} = -o M_0 e^{-oT} = -o M_r \quad (5th)$$

thereafter

$$o = - \frac{dM_r}{M_r dT} \quad (6th)$$

The meaning of  $O$  is, therefore: The part of the residual particles that falls away in the given time unit.

Between the ordinary heat-motion and the point-heats exists at first a considerable time difference. But with the usual heat-motion it happens that a large particle gets by addition of impacts from the same direction exceptional velocity and, therefore, differs from its surroundings, and so with very low general temperature evaporates. But with the action upon the halogen silver particles, cells, gelatine particles, etc., coming into the question, the point-

heat signifies that little groups of particles differ very strongly from the average motion-state of others (for a short time) without influencing considerably the state of the others. Then, as the example that we had before shows, the water spouts out highly where the stone has fallen into the lake, but the surface of the lake and its temperature do not show any considerable change. If a piece of gelatine be made more fluid by heat, then in this experiment the average state of all gelatine particles (of large size) will be almost the same after several minutes. The whole piece of gelatine as far as it can be measured, appears to be warmer. If a hen's egg is coagulated by the temperature it is then equally heated and coagulated. If this is the result of point-heat, then there is no general temperature-raising. The temperature-raising conserves (as is self-evident) and also evident by ways of calculation) the single big particles we are interested in, and in time almost equally, but the point-heat occurs only after an exponential-function. With the point-heat in every moment the relation of the energy-concentration in comparison with the surroundings is much greater. It may be asked which mass-complex can generally take part in the phenomena of point-heat. At what least number of moving particles may we speak about heat? The ionization and recombination in the first moment concern two mass-particles, the absolute weight and specific heat of which are known, but it results, that energy imparted to these particles may correspond with the immense temperature, if indeed one can speak here about temperature. It seems to be more conclusive to consider the question going out from the disposed energy and to reflect upon what amount of mass can be heated with this energy to such a temperature, which has any influence upon the process concerned here. This amount of particles of matter I should call "the critical amount." If the energy spreads on to a larger number of particles, then the energy-concentration will be too small for this phenomenon to produce anything measurable.

The above mentioned facts will be clear by means of the following example: Let us imagine a cube of specific weight and specific heat = 1, consisting of albumen-molecules with the molecular weight 5000, then we can say, that the temperature of about  $100^\circ$  is critical for an albumen-molecule, because at about  $50^\circ$  albumen begins to coagulate. If we calculate with  $100^\circ$  and a specific heat equal = 1, we find the loss of electrons, about 12 volts, would signify such an ionization-energy, which in the heat expressed would heat



such an albumen-molecule over  $100^\circ$ . If this energy spreads onto a mass 10 or 100 times as large, then the temperature will be too much decreased and nothing in particular can happen further. The sense of the point-heat-theory is that the action must be distributed not equally to all the particles, as it may really be thought in the average at the heating, but it must be concerned with the place, where the heat is concentrated on a very small "critical mass" and produces a critical accumulation (temperature).

If for instance the radiation with x-rays produces very quick electrons, then we can suppose that within one single cell which is made up of an immense quantity of molecules, there is produced in the path of an electron a very large number of point-heats. We can also think that any of the impacts correspond to a larger loss in volts of the electrons. At the small tension-loss, where the ionization-work is about two volts this work must approach the limit where it no longer acts and, therefore, does not produce any more changes and does not react on the photographic plate, or human cell, or anything like that, excluding perhaps (if  $O$  is too large and if many such impacts are produced in the same time and at the same place) fluorescent flashes. It may be thought that, with the absorption of x-rays as a result of point-heat, dissipation takes place, occurring not only on the surface, but also in the depth.

The experimental examination of these ideas is a part of our program, but is still incomplete.

As it is very easy to calculate how much ray-energy enters through one square centimeter of surface radiated and how much energy is absorbed in one cubic centimeter, so it may be shown by means of simple calculation, how many point-heats are produced in one second in such a cubic centimeter of body irradiated, by supposing that the energy of such an impact (which is a product of the unit-charge on the speed-loss) corresponds with the number of 10 volts. This number can be compared with (also approximately calculated) that of albumen-molecules or even of cells or of photographic particles in such a tube. This is the value of  $O$  for the albumen molecule of cells, etc. It can be computed and then compared with the experiment. We have compared in the Institute (Dr. Blau and Dr. Altenburger) our results with other published material, especially in photographic literature and several results were good. This will be the subject of a special publication.

The discussion as to whether x-rays of different hardness are different medicaments or not, is given, owing to this consideration, a very clear basis. In certain aspects the action of light, soft x-rays and of hard x-rays, is on the whole similar. If the point-heat-theory is right, then the statement above mentioned is to be explained in the following way:

All these three kinds are acting by means of point-heats and now it is possible, that at the irradiation even with the different wave-frequencies the disintegration of their energy goes in almost equal portions, for instance, each time the energy is about 10 volts multiplied with the unit-charge. Then the action upon the particles, the size of albumen-molecule which have been struck once, are equal, but already in relation to a cell they are quite immensely different and still more different in relation to a cell-complex. And as we have above calculated, the same amount of energy absorbed in any place, influences 100,000 times as many cells, if the frequency is only 10 times as great. Then, owing to this cause, the rays of different hardness are different medicaments, but it may be the case that the waves of different frequency which liberate the electrons of different velocity, are disintegrating in differently large steps, that is, that the quick electrons are able to lose a different number of volts than the slow electrons. In this case the point-heats are quite different among themselves.

#### LOCAL AND STIMULATING ACTION

The number of the particles struck decreases at first quickly, and afterwards more and more slowly. Practically the rest is unimportant, if the total radiation was great, but we can always find sensitive cells which are not damaged.

Further, there are always destroyed a certain number of relatively more resistant cells in which various changes have taken place.

These two consequences following from the theory do not at all deny the value of radiation in therapy. But they are showing what is to be expected.

After each radiation, cells of all kinds are injured, the sensitive cells in a far greater percentage. For example: If ninety per cent of the carcinoma cells in the radiated area are killed, perhaps five per cent of the essentially resistive cells (normal skin, bowels, epithelium) in this zone are likewise similarly destroyed, and also all the other cells in a certain percentage, namely, those which by comparison

with the average have endured a very great number of bombardments. But it is true that even at any small radiation some of the cells must be destroyed; it is indeed the case with the more sensitive cells, and it happens also with less sensitive cells. The calculation thus shows that even with a small radiation some cells will be struck many times. It may be accepted, that many phenomena, which, especially recently, are known as stimulating action, proceed from this. The word "stimulation" receives now a definite content, which it has not previously had. Any part of the body or a plant is so irradiated that according to the order of size only small percentages of that energy are absorbed, as at the ordinary radiation, which leads to the macroscopic effects (reddening and so on), then it is not at all uncertain, that the actions of the point-heats upon single cells are so accumulated, as these cells are injured. The microscopic inspection shows, that all this can have taken place. Nevertheless, in accordance with Caspari's ideas the processes of cell-destruction, must now act in the circulation and can produce very severe reactions, which, contrary to ordinary radiation effects are primarily not local. Secondly, they can indeed be local, that is, localize themselves at any place in the body, because in that place is disposed a certain organ or there is a locus minoris resistentiae. By that there occurs from the stimulating action another entirely different and remote phenomenon, viz., the local destruction. The stimulating action has a basis in the injury of a correspondingly small number of cells, upon which the body reacts by compensating or overcompensating. My opinion is that from the investigation of this phenomenon much is to be expected.

It seems perhaps too early and too hazardous to publish such a theory without encircling calculations and without experimental examination, only, so to speak, with a sketch and with only qualitative reasons. But I venture to do it because we in our Institute seem to have found some confirmation of a quantitative kind, which may be published later. Also because it will sooner be established, how far this representation coincides with the facts and whether it can be useful as a working hypothesis provided that scientific men become acquainted with it. Whether this theory has little value or whether it is entirely wrong, will more quickly be found out in this way. On the other hand, if it is correct, then by this means it will the sooner become useful.



# Roentgenologic-Pathologic Conferences\*

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THE PURPOSE of this joint paper is an attempt to promote cooperation between the roentgenologist and pathologist. The roentgenologist who is confronted with the varied problems presented in a general diagnostic x-ray laboratory presents conclusions which have much or little value according as they are based upon proper concepts of pathology. The most important preliminary study for the roentgenologist is pathology. His book shelves should contain as many volumes on pathology as on roentgenology. If he is to be progressive, he must be a constant student of pathology and embrace every opportunity to examine the contour and density of the organs of which he has records upon his plates.

At the University of Michigan every Friday afternoon during the school year there is held a pathologic conference, in which the clinicians and roentgenologists give their clinical diagnoses and where the pathologist as the court of last resort gives the macroscopic and microscopic findings. The correlation between the clinical symptoms as shown by the methods of physical examination and by the roentgen ray is reviewed and commented upon in the light of autopsy data. The advantages of such a weekly conference are: first, the stimulus to careful and precise work; and second, the opportunity either to be fortified in the data of complex cases, or to profit by mistakes.

Many roentgenologists fall into routine habits of procedure and do not always stop to question whether these are based upon fundamental concepts of pathology. It is only by the maintenance of a constant relation between the roentgenologic and pathologic laboratory that essential progress will be made. The following cases chosen from the clinical-pathologic conferences at the University of Michigan will illustrate the method and serve to emphasize the practical value of such cooperation between the clinics and the pathologic laboratory.

CASE I.—M. H., age 38—Department of Dermatology.

\*—From the Departments of Roentgenology and Pathology, University of Michigan, Ann Arbor.

\*—Read Before the Meeting of the Radiological Society of North America, Windsor, Canada, December, 1922.

*Clinical History:* Admitted to the hospital on August 4th, 1922. At the time of his admittance his complaint was a swollen left testicle.

Fifteen years ago developed two hard painless penile lesions following exposure. These were cauterized; no subsequent eruption or sore mouth. In November, 1921, he developed a swollen testicle which was very painful. Two months before examination, Wassermann examination was positive and he began taking mercury by mouth and by inunctions with no relief of symptoms. Examination at entrance showed left testicle about the size of a hen's egg, consistency of a rubber ball, almost cartilaginous; surface nodular. No involvement of vas deferens. Slight general adenitis. Wassermann 4 plus. He was given injections of arsphenamin on the 7th, 11th, 18th and 25th of August and 1st and 8th of September. On the 8th of September he became suddenly cyanosed and dyspneic and died before any treatment could be administered. The admittance diagnosis was gumma of testicle.

Postero-anterior stereo of the chest: Examination of these plates show both lung fields almost completely filled with numerous spherical dense shadows of varying sizes and densities from the size of a shot to the size of a small orange. Both extreme apices appear to be clear although there are no especial lung fields selected for predominance of these shadows. This is certainly not

tuberculosis, as the involvement does not appear to have increased the bronchovascular structures. These shadows appear more to resemble those of sarcoma metastases.

Stereoscopic plates made of the pelvis showing the upper thirds of the right and left femora. The hip joints are symmetrically shown, and show no evidence of bone pathology. The plates are made too low to show the lower spine.

*Pathological Report:* Autopsy 1342—A-23-AA—Department of Pathology, University of Michigan, Ann Arbor. M. H., age 38, male. Died 9-8-22, 9:05 P. M. Autopsy 9-9-22, 12:30 P. M. Clinical Diagnosis: "Gumma of Testis? Lues. Cause of death, cerebral embolus?"

The complete pathological findings in this case were: Malignant teratoma of left testis (medullary carcinoma with sarco-carcinomatous areas). Multiple metastases in lungs, liver, spleen, bronchial, mediastinal and cervical lymph nodes, retroperitoneal lymph nodes and capsule of left kidney. Ascending lymphogenous metastasis, most marked on left side. Thrombosis of left external and internal iliac veins with multiple pulmonary emboli. Congestion and edema of lungs. Atrophy, congestion, edema and parenchymatous degeneration of all organs. Early atherosclerosis of aorta and iliacs. Atrophy of pituitary and parathyroids. Excess of chromaffin cells in adrenals. Total aspermatogenesis.

*Pathology of Thorax.* Diaphragm was at the 6th interspace on the right and at the 7th on the left. No free gas or fluid in thorax. Pleural cavities completely obliterated by old adhesions. Both lungs were very voluminous, lung borders nearly meeting in the mid-line. The anterior mediastinum contained many enlarged lymph nodes. No remains of thymus were seen. The apex of the heart was inside the nipple line behind the sixth rib. Slightly enlarged. Pericardial sac negative. Heart negative with the exception of a moderate dilatation of the left ventricle, and slight sclerosis of the larger coronary branches. The lungs were completely covered with pleural adhesions. Beneath the visceral pleura and occasionally extending into it were numerous round nodules varying in size. On section the cut surface of the lungs showed numerous circumscribed, round, soft medullary nodules of a yellowish or greenish



Fig. 1—Case I. Posteroanterior plate of chest. Rounded shadows represent metastatic areas of neoplasm. X-ray report, shadows sarcomatous. Pathologic report showed them to be carcinomatous, metastasis being by the hematogenous route, from a primary malignant teratoma of left testis.

color, presenting cheesy, necrotic centers. They varied in size from that of a pea to a base ball. The smaller ones were firmer, more creamy in color and showed less central softening. They presented the appearance of a metastatic medullary neoplasm of carcinoma type. The cut surface of the metastases yielded on scraping an abundant cell juice. Between the nodules the lung tissue showed marked congestion, edema and atelectasis. In one of the primary divisions of the left pulmonary artery a mixed embolus was found. The bronchial nodes were greatly enlarged; on section they presented the same appearance as the nodules in the lungs, and the metastases found in other parts of the body, and the primary growth in the left testis.

The microscopic examination of the primary mass replacing the left testis showed it to be a neoplasm of the type of a medullary papilliferous cystocarcinoma. In localized areas the stroma was so cellular as to warrant the use of the descriptive term "sarcomatous" for such areas. No other teratoid structures were found, but the type of the neoplasm is that of one of the more common malignant transformations of testicular teratoma. The metastases throughout the body present the same neoplastic type as that of the primary. The metastasis is both lymphogenous and haematogenous. The marked involvement of the lungs is a characteristic common to all forms of malignant testicular tumors.

No histological changes of syphilis were found anywhere in the body. The clinical diagnosis of lues is unsupported by the pathological findings. We believe he did not have syphilis. The positive Wassermann is explainable by the advanced carcinomatosis. In our experience a 4 plus positive Wassermann reaction is of frequent occurrence in patients suffering from advanced carcinoma or sarcoma, particularly when such malignancy is of teratoid origin.

The pathological findings support the x-ray diagnosis of metastatic neo-

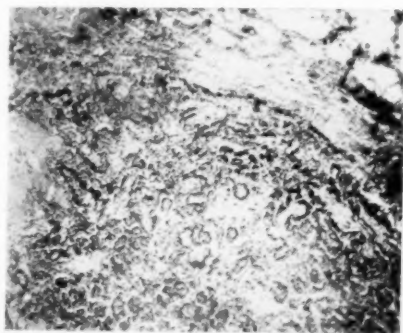


Fig. 3—Photomicrograph of metastatic adenocarcinoma, from primary malignant adenocarcinoma of left testis.

plasm in the lungs. Because of the sharply-defined and regular outlines of the neoplasm shadows the growth was regarded as either sarcoma or hypernephroma by the members of the radiological staff. It was neither; it was a carcinoma. The differential diagnosis of metastatic sarcoma and carcinoma of the lung in the x-ray plate, on the grounds of difference in the manner of metastasis, hematogenous or lymphogenous, can not be supported from a pathological standpoint. Both metastatic carcinoma and sarcoma may present the same x-ray appearance.

#### CASE II.—M. S. W., age 7—Surgery and Pediatrics.

**Clinical History:** Entered the hospital on the 12th of November, 1921, with swelling of the right foot and right inguinal glands. Two months previous to entrance, swelling of leg appeared, and increased rapidly with no constitutional symptoms. A growth was removed from the leg previous to entrance into the University Hospital. On the right foot is a swelling of the dorsal surface over the metatarsal, size of a walnut, not tender on manipulation. Inguinal glands palpable and matted. On the 21st of January, 1922, the growth on the foot was removed, also part of the glands in the inguinal region. The operation was followed by a series of x-ray treatments during January and February, 1922.

He was discharged from the hospital on March 29th, 1922, and readmitted April 29, 1922. There was a recurrence of the tumor on the foot. X-ray treatments were resumed. Local operation on the foot. On September 7, 1922, the foot was amputated. In October he complained of pain in the back with incontinence of urine and feces. The latter part of October, 1922, there was a loss of sensation below the area supplied by the second dorsal nerve. Paralysis of the bladder developed. The patient grew gradually worse with slow respiration and rapid heart action. Death occurred on November 1, 1922.

**Examination of Chest:** This patient has had a former examination of the chest, and comparison of these plates with those of the former shows evidence of appearance of a new shadow in the chest. This is dense, sharply outlined and appears high on the right side posteriorly and beneath the first, second and third ribs. We take this to be a shadow of metastasis into the posterior mediastinal space or possibly into the lung, as we are unable to determine accurately its location from these plates.

**Pathological Report:** Autopsy 1366, A-47-AA. M. S. W., aged 7, died 11-1-22 at 2:00 P. M., autopsied at 1:30 P. M., 11-2-22. Clinical Diagnosis: Generalized sarcomatosis, primary in right foot.

**Pathological Diagnosis:** Multiple metastases of an alveolar large round cell sarcoma (primary in right foot; amputation two months previously). General atrophy and passive congestion. Acute cystitis. Left hydrothorax.

**Pathology of Thorax:** Diaphragm lower border of fourth rib on the right, upper border of fifth rib on the left. No gas or air in thoracic cavity. Apex of heart in fifth interspace in mid-clavicular line. Left lung completely atelectatic. Left pleural cavity contained 700 c.c. of a clear straw-colored fluid. No thymic tissue visible to naked eye. Heart slightly enlarged, otherwise negative. Left lung showed nearly complete atelectasis, only a small portion of the peripheral portions being air-containing. Scattered over the pleural surface and throughout the lung parenchyma were numerous firm, round, whitish nodules, varying in size from that of a millet seed to that of a hickory nut. On scraping, the nodules yielded only a small amount of tissue juice. Between the nodules the lung

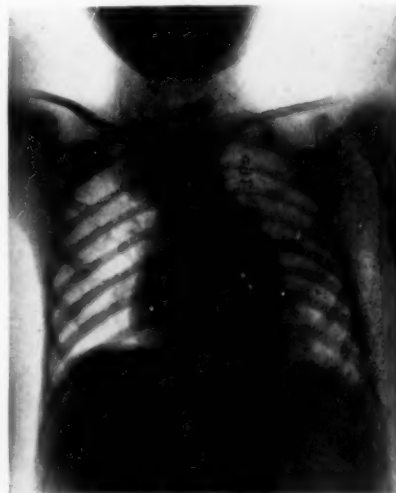


Fig. 4—Case II. Posteroanterior plate shows adventitious shadow in upper right lung field, suggestive of neoplasm.

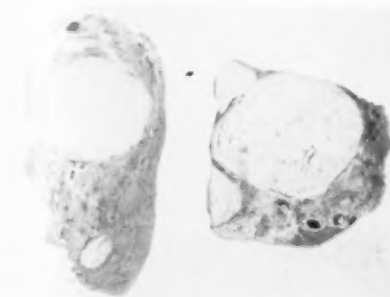


Fig. 2—Metastatic carcinoma nodules in portions of lung (natural size), from primary malignant teratoma of left testis.

tissue showed atelectasis, congestion and edema. The left bronchial nodes were greatly enlarged, on section they presented the same appearance as did the pulmonary nodules. The entire parietal and diaphragmatic pleura on the left side was studded with similar metastatic nodules. Extending from the diaphragm, along the pleural ligament to the hilus of the left lung there was a thick cord of neoplasm of the same characteristics. The right lung was air-containing throughout. There were no pleural adhesions on the right except at the apex, and no fluid in the right pleural cavity. On the right apex there was a metastatic nodule of the size of a plum, growing from the parietal pleura into the apex of the lung. On section, only a few small metastases can be seen scattered through the lung tissue. The right bronchial nodes were not enlarged. With the exception of the apical nodule, the parietal and visceral pleurae on the right showed no other metastases. Lung tissue showed no other changes except congestion and edema. No metastases were found in head or in the bones. The spinal cord was not examined.

The microscopic examination of the nodules from the lungs, bronchial nodes, chest wall and diaphragm showed the structure of an alveolar large round cell sarcoma; in the older metastases the cells were oval, or slightly spindle shaped. The metastases in the retroperitoneal glands, peritoneum, kidneys and right popliteal space showed the same structure of alveolar sarcoma. This accords with the structure of the primary growth in right foot, as shown by repeated diagnostic examinations made in the laboratory from tissue taken from the foot-growth before and after amputation of the foot. In the earliest specimens the cells of the sarcoma were more uniformly spindle-shaped; with recurrence and generalization the growth was more rapid and

less differentiated, so that in the majority of the nodules they were round. Originally an alveolar spindle-cell fibrosarcoma the neoplasm at this stage presents the appearance of an alveolar round-cell sarcoma.

The x-ray plates of this case were taken nearly three weeks before death. At autopsy nothing was found on the right side to explain the shadow seen on that side beneath the first, second and third ribs except the localized metastasis and pleural adhesion at the right apex. The nodule in the pleura was about the size of a medium-sized plum; when cut into, it was found to be adherent to the first costal cartilage which was completely encircled and thickened by the growth. The size of this localized metastasis was entirely out of proportion to the shadow, and does not seem sufficient to explain it. On the other hand the plates show no evidence of the extensive metastases and hydrothorax on the left side. The development of these conditions can, therefore, be assumed to have taken place, for the greater part, in the interval between the taking of the plates and the death of the patient.

CASE III.—R. E. H., American, age 26, a farmer by occupation.

*Clinical History:* His complaints are, sour stomach with gas, burning pain and eructation. In the patient's own mind the trouble began at the age of 15. At that time he was struck in the abdomen by the handle of a plow and for four years after had irregular, somewhat infrequent attacks of "stomach trouble." At the age of 19, his symptoms became so annoying that he sought help in a hospital in the northern part of the state. He returned home without improvement. While in the hospital he learned the use of the stomach tube and he has been using this continuously ever since. On some days he has pumped his stomach as often as five or six times. He vomited occasionally before he began to use the stomach tube, and very infrequently since and only at such times when he was too far away from his tube to get it before vomiting would come on. He has seen fresh blood on only one occasion during the last spring. There has never been any bright blood in stools. He has always enjoyed good appetite, even up to the present time. His maximum weight was 172 pounds. He weighs 127 pounds at the present time.

*Ward Notes:* He entered on the 22nd of September, 1922. On the 26th he was complaining very bitterly of a burning pain in the mid-epigastric region. He had not been permitted to use the stomach tube while on the ward.

He had been observed to eat anything that was offered him in the usual house diet. On the 1st of October, about 10:30 A. M., while the ward doctor was at the patient's bed, he picked up a glass of liquid nourishment and as he was about to place it to his lips, it dropped into his lap and immediately the patient went into a tonic convulsion, with marked contractures, passing very shortly into a clonic convulsion which lasted possibly a minute and a half, at the conclusion of which he was markedly cyanotic, eyeballs rolled upward, pupils contracted, respirations labored, extremities cold. At the end of a ten minute period he still failed to respond to questions or to marked skin stimulation. On the following day he was still in a semi-comatose condition and would respond to a sharp command by opening his eyes and staring blankly. He made purposeless movements with his right hand, seeming to be attempting to touch the top of his head.

At this period in the patient's stay, his sister appeared, and on questioning her it was learned that the patient had had similar seizures previously. The first occurred last May. This was the third to her knowledge. Upon the two previous occasions it was stated that he had remained in the semi-comatose condition for from eight days to two weeks, during which time he had refused all nourishment and had rallied from the condition quite suddenly, coming back to full consciousness and getting out of bed in the course of an hour.

The patient died on October 3rd, without ever having regained full consciousness. Just before his death he went through another mild convulsive seizure.

Laboratory examinations showed the following: Hemoglobin, 56 per cent; round blood cell count, 4,400,000; white blood cell count, 8,800; blood pressure, 110/65; differential count showed a slight preponderance of lymphocytes, mostly small, otherwise normal. Gastric analysis showed no

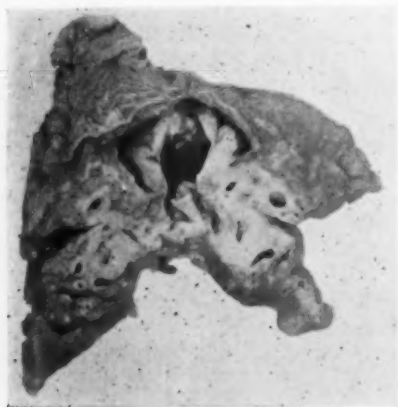


Fig. 5—Gross appearances of lung of Case II. Metastatic alveolar round-cell sarcoma of bronchial nodes and lungs; primary in right foot.

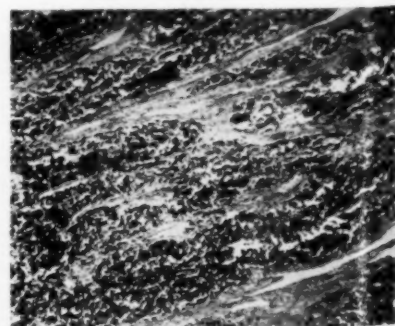


Fig. 6—Photomicrograph of metastatic alveolar round-cell sarcoma of lung; primary in right foot. Case II.



free hydrochloric acid in the fasting specimen with a total acidity of 33 per cent. Test meal was drawn 45 minutes after ingestion and showed free hydrochloric acid, 26 per cent; total acid, 58 per cent. Stool was negative for blood. Spinal fluid negative. Urine negative.

Clinical diagnosis was gastric ulcer.

**X-Ray Examination:** Erect position. No previous meal. Suspension given. Drops through a large secretion zone. Peristalsis begins immediately. Stomach freely movable. Outer border of a lighter density. No filling of the cap. Peristalsis moves entirely to the antral end of the stomach, which is blunt. Peristalsis deep.

**Dorsal position:** Immense gastric shadow. Peristaltic waves almost sever the gastric shadows. Two wave type. Dimpled antrum. Small amount of barium seen in the second portion of duodenum but no cap noted, plate. **Fluoroscopic examination** at 24 hours shows a large gastric residue. Peristalsis cuts deep. No cap seen. Large amount of gas throughout the large bowel. Some in descending colon. Stomach shadow is at the level of the pubis. **Plate at 9 o'clock:** Large gastric shadow. Deep peristaltic wave. No cap. **Plate at 3 o'clock:** Large gastric residue. Some barium in the small bowel. **Plate at 24 hours:** Immense gastric shadow. Low in the pelvis. Some barium in the colon.

Diagnosis: Gastric ulcer with obstruction.

**Pathological Report:** Autopsy 1352. A-33-AA. R. E. H., age 26. Died 10-3-22, 7:45 P. M. Autopsy 10-4-22, at 10:00 A. M.

**Clinical Diagnosis:** Gastric ulcer.

**Pathological Diagnosis:** Multiple acute abscesses of lung. Purulent em-

boli in pulmonary vessels. Metastatic pneumonia. Diffuse acute purulent bronchitis. Aspiration pneumonia (?). Congestion, edema, multiple hemorrhages and hemorrhagic infarctions of lungs. Chronic parenchymatous degenerative nephritis with marked calcification. Toxemia (Sub-nitrate of bismuth or mercurial poisoning ?). Chronic leptomenigitis. Early syphilitic aortitis (?). Localized renal, coronary and central sclerosis. Total aspermatogenesis. Persistent hyperplastic thymus. Asthenic constitution. Heterotopia of left kidney with anomalous vascular supply. Spastic paraplegia of stomach with extreme dilatation. Spasmophile constitution (Tetany). Small healed erosion in prepyloric region. Chronic obliterative appendicitis. Atrophy, passive congestion and parenchymatous degeneration of all organs.

**Pathology of Abdomen:** No gas or fluid in peritoneal cavity. The omentum was almost devoid of fat; it was free except for a few small adhesions to the abdominal wall in the left upper quadrant. It was gathered up for the greater part along the greater curvature of the stomach. Diaphragm high, fourth rib on the right; fourth interspace on the left. Peritoneum moist-shining throughout. The stomach was enormously dilated, reaching to the pubis. The colon seemed unusually long; the transverse colon was thrown into a V-shape, the point of the V being upward, behind and beneath the lesser curvature of the stomach. Both splenic and hepatic flexures thrown into large folds. It was only moderately distended with gas, and its lumen was not unusually enlarged. The appendix was retrocecal, bound down by adhesions; it measured 6 cm. in length. The small

intestine contained a small amount of grayish, yellowish-brown fluid. Its wall showed marked congestion. The bile passages were patent. No pathologic condition of gall bladder. The pylorus was unusually small, requiring a marked degree of pressure to force the tip of the little finger through. The tightness of the pyloric ring was not due to muscular hypertrophy and induration of the ring, but either to an actual developmental disturbance or a persistent tonicity. The greatly dilated stomach cavity contained a large quantity of gas and bile-stained fluid in which numerous grape-seeds and corn kernels were suspended. The stomach wall was thinner than normal, but not proportionate to the degree of dilation. The mucosa itself appeared thin and grayish, somewhat congested towards the cardiac end. The cardia was dilated, taking two fingers easily. No ulcer or erosion in the mucosa of the stomach in any portion. About 2 cm. above the pyloric ring there was present in the mucosa a small area of induration beneath the mucosa, probably a healed erosion or small ulcer.

The microscopical examination of the stomach wall showed a diffuse chronic catarrhal gastritis of moderate degree. The area of induration in the prepyloric space showed no recent process. The mucosa was intact over an area of slight fibrosis in the sub-mucosa; a healed small ulcer or erosion, most probably a small healed traumatic lesion due to use of stomach tube.

This case presents a complicated pathology. The patient was a man of inferior constitution, as shown by his persistent thymus, asthenic build, anomaly of left kidney and pylorus. He had a latent syphilis, as shown by the focal chronic leptomenigitis and



Fig. 7—Case III. Plate immediately after barium meal. Hyperperistalsis. No filling of cap.



Fig. 8—Case III. Six hour plate. Large residue. No outline of cap.



Fig. 9—Case III. Twenty-four hour plate. Large amount of fluid in stomach with considerable barium still retained.

aortitis of syphilitic type. He had also a chronic recurrent obliterative appendicitis. Acquiring the habit of stomach-washing, he increased his stomach dilatation to the point of temporary closures of the pyloric ring through spastic increase in tonicity of the pyloric ring or kinking of the pylorus due to downward pull of the greatly distended stomach. Associated with this condition he had had well-defined attacks of tetany. In this respect his condition is best described as showing the characteristics of the spasmophile constitution. He had also a marked chronic toxic degenerative nephritis of the type usually produced by mercurial poisoning, but also claimed by some writers to occur in poisoning with bismuth-subnitrate. The possibility of the latter may be assumed in connection with his stomach condition, although toxicologists are not agreed as to the toxic nature of subnitrate of bismuth. The immediate cause of death is to be found in the wide-spread pulmonary lesions. These are best explained as secondary purulent processes dependent upon a primary localized area of aspiration pneumonia with abscess formation.

The autopsy findings do not confirm the clinical and roentgenological diagnoses of gastric ulcer. There was no active ulcer or erosion; the small area of sub-mucosal fibrosis in the prepyloric space represented a small healed lesion of no bearing upon the present condition. The pyloric obstruction can be satisfactorily explained as due to a spastic closure of the pylorus associated with the downward pull of the dilated stomach. This condition resembles that seen in post-operative gastric paraplegia with tetany.

#### CASE IV.—H. B. S. Surgery and Internal Medicine.

**Clinical History:** This patient is 67 years of age, an American, bachelor. Chief complaint is weakness, lack of appetite and a pain in the epigastric region. His trouble dates back only three months, when he began to be seriously annoyed by a pain in the stomach. It was present day and night for a time and then for a few weeks eased up considerably. It recurred, worse than ever, and has been present continuously ever since and the patient has been in bed for the last four or five days before his entrance to the hospital. His appetite was unimpaired up to one week ago. According to his statement, however, he has continued to lose weight slowly but surely for the past three months. Weakness was an early symptom. He vomited but four times in the past three months, although on every occasion he has vomited typical coffee ground material and in such

amounts that retention is quite evident. His bowels have been constipated, not tarry, and no fresh blood observed.

**Ward Notes:** This patient was in an extreme state of emaciation on his entrance and examination readily showed the patient to be suffering from a pyloric obstruction, as he had a tremendously distended stomach, readily observable, with marked peristaltic waves passing from left to right. The patient gave ample demonstration of the clinical diagnosis on his second day after entrance, when he vomited at least three quarts of black, coffee-ground material and in this material was food which the patient recognized as having been eaten two or three days previously. He was considered to be in extremis with but one chance which the surgeons consented to give him. Operation was done, a rapid gastro-enterostomy, but the patient survived only twelve hours.

**X-Ray Examination:** Erect position. Acacia mixture given. The patient had some difficulty in swallowing, but we could note no evidence of a lesion in the esophagus. The stomach is enormous, apparently filled with fluid as the mixture gets to the fluid and descends to the most dependent portion of stomach, just above the pubis. The patient was too weak to stand up for the remainder of the examination. No definite defect was noted at this time.

The examination in the recumbent position was not satisfactory. Patient vomited a large amount of coffee-grounds material. Stomach was faintly outlined, enormous. Apparently a large obstruction at the antral end. Plate.



Fig. 10—Case III. Gross appearances of enormously dilated stomach. Pylorus and duodenum at middle left.

Twenty-four hour fluoroscopic examination. Enormous gastric residue, apparently due to an almost complete retention in the stomach; only irregular shadows in the remainder of the bowel. Plate.

Review of the fluoroscopic examination and study of the plates shows an enormous aperistaltic stomach with a total obstruction. There seems to be no evidence of barium shadows in the upper or lower bowel. We think this amount of retention is probably due to an obstructive lesion which is apparently a malignant lesion, not showing as a gastric defect.

**Pathological Report:** Autopsy 1363, A-44-AA. H. B. S., male, age 67. Died 10-27-22 at 2:00 A. M. Autopsy 10-27-22 at 9:30 A. M.

**Clinical Diagnosis:** Cancer of pylorus with complete obstruction.

**Roentgenological Diagnosis:** Obstructive lesion of pylorus, apparently



Fig. 11—Case IV. Plate immediately after barium meal. No antral defect. Apparently complete obstruction.



Fig. 12—Case IV. Twenty-four hour plate shows large gastric retention with practically no barium found in the intestines.

a malignant lesion, not showing as a gastric defect.

**Pathological Diagnosis:** Primary adenocarcinoma of pancreas; marked chronic interstitial pancreatitis; dilatation of pancreatic ducts; diffuse carcinomatous infiltration of pancreas, scirrhus in type. Multiple metastases in liver, retroperitoneal nodes, omentum and retroperitoneal tissues. Death postoperative (gastro-enterostomy). Marked marasmus. Old syphilis (myocarditis, aortitis, orchitis, pancreatitis). Multiple anemic infarcts of kidneys. Old tubercles of bronchial nodes and lungs, still active. Acute miliary tuberculosis of liver. Chronic adhesive pleuritis. Chronic perisplenitis. Chronic prostatitis and cystitis. Recent thrombosis of prostatic plexus extending into right iliac vein and vena cava. Atrophy and passive congestion of all organs. Emphysema. Healed scar in right upper arm. Terminal lobular pneumonia.

**Pathology of Stomach:** Just behind the pyloric ring there was a firm hard mass about the size of an apple, representing the head of the pancreas, which kinked the pylorus and first portion of the duodenum anteriorly. On opening the duodenum and passing the index finger towards the mass, the pylorus was found to be patent, but the finger could be pushed through it only by bringing it sharply anteriorly and then bending it slightly posteriorly. This pyloric obstruction was due wholly to the adhesion externally and pull of the enlarged head of the pancreas. Over this mass the mucosa of the duodenum just below the pyloric ring showed a shallow funnel-shaped depression with slight puckering, suggesting an old healed ulcer. The mucosa of the stomach and duodenum was everywhere intact. The first portion of the jejunum was securely sutured to the anterior portion of the stomach wall near the pylorus. The surgical area showed no leakage, hemorrhage or evidence of infection. The stomach was

almost completely filled with a dark grayish mud-like fluid of blood and barium. Section of the pancreas showed head and body of the gland to be wholly replaced by a scirrhus neoplasm, while the tail showed numerous areas of firm yellowish neoplasm with a very small amount of pancreatic tissue remaining. The main pancreatic duct was open, dilated, and filled with a glistening cloudy fluid. The biliary passages were patent; and there was no jaundice, a point of importance with relation to the differential diagnosis of carcinoma of the pancreas.

The microscopical examination showed the greater part of the pancreas to be replaced by a scirrhus adenocarcinoma. The acini were practically absent; the dilated ducts and islands of Langerhans preserved. At the point of adhesion between the enlarged head and the duodenum the carcinoma infiltrated the subserosa and outer muscle coats of the adherent portions of the duodenum and pyloric ring. In no place was the mucosa infiltrated.

The pathological findings, therefore, confirm the x-ray diagnosis of "pyloric obstruction without defect of the stomach wall, probably of malignant origin."

**CASE V.**—T. T., age 16 months. *Pediatrics and Otology.*

**Clinical History:** Admitted to the hospital November 8, 1922. There was a history of aspiration of a peanut seven weeks before admittance followed by violent choking and coughing. Cough has persisted. There have been periods of remission. Just before entrance patient seemed much worse with more difficulty in respiration and frequent attacks of choking. Physical examination showed the patient to be acutely ill. Picture was one of sepsis with sunken eyes, pallor, prostration, and a temperature of 103 Fahrenheit. Patient showed almost continuous cough. Over the right back were loud rales with some asthmatic breathing, no crepitant rales. Left chest showed a few rales. Diagnosis on admission was bronchopneumonia with foreign body in the right bronchus. He seemed

fairly comfortable during the afternoon and evening of the day of admission, until suddenly early the next morning he showed a severe coughing spell with severe dyspnea. Artificial respiration and oxygen were used without avail.

**X-Ray Examination:** Stereoscopic plates of the chest made in the anteroposterior direction. These plates show an uneven illumination of the lung fields, the upper right lung field being quite dark, indicating diminished density. The middle lung field shows mild opacities and there is a decided opacity in the lower right lung field. Careful survey of the right lung field convinces us that there is a beginning bronchopneumonia of the upper lobe, a fairly well established bronchopneumonia in the middle lobe and a very advanced bronchopneumonia in the lower lobe. The left lung field shows good transparency of the upper lobe. The lower lobe shows an opacity which is not quite similar to the bronchopneumonia on the other side. It may possibly be due to slight rotation and the superimposed shadow of the heart. From the appearance of the right lung field we would think that aside from the evidence of infection in the three lobes that there was a non-opaque foreign body in the right bronchus.

**Pathological Report:** Autopsy 1371. A-52-AA. T. T., aged 16 months. Died 11-9-22 at 5:00 A. M. Autopsy 11-9-22 at 10:00 A. M.

**Clinical Diagnosis:** Right bronchopneumonia with foreign body (*Pediatrics*). Bilateral pneumonia, foreign body. Lung abscess on right (*Otology*). Early bronchopneumonia of right upper lobe, well-established bronchopneumonia in middle lobe and advanced bronchopneumonia in lower

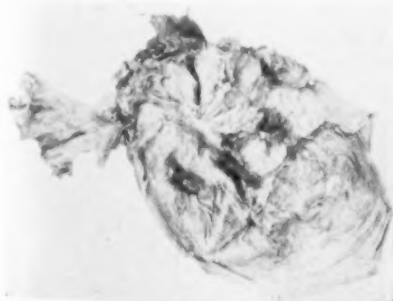


Fig. 13—Case IV. Gross appearances of dilated stomach. At A an incision through the intact stomach wall shows an incision into the dense carcinoma mass in the head of the pancreas to which the pyloric and duodenal obstruction were due.

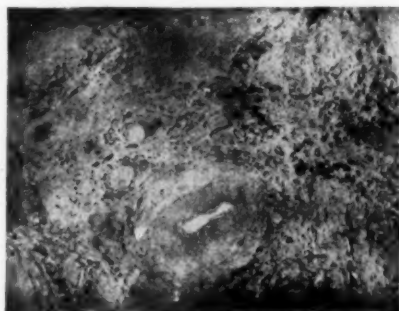


Fig. 14—Photomicrograph of scirrhus carcinoma of pancreas. Case IV.

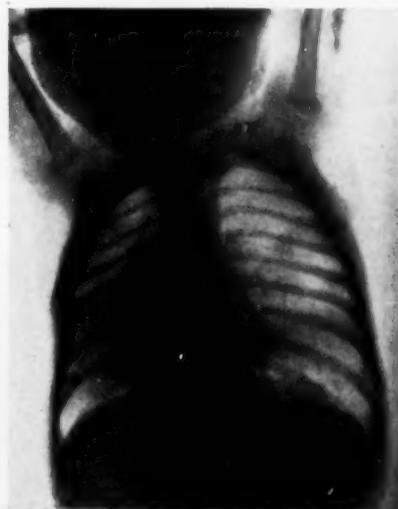


Fig. 15—Case V. Anteroposterior plate of chest. Note over-distension of right lung, with slight opacity in upper lobe, mild opacity in middle lobe, and marked opacity in right lower lobe. Increased density in lower left.



lobe. Non-opaque foreign body in the right bronchus (Roentgenology).

**Pathological Diagnosis:** Aspiration of peanut, lodging in right main bronchus just beyond the bifurcation. Diffuse right-sided purulent bronchitis, bronchiectasis and bronchiectatic abscesses containing young colonies of actinomyces. Right-sided pleuritis. Flooding of left bronchial tree with pus. Death from suffocation. Partial atelectasis of left lung. Status thymicolymphaticus. Hypoplasia of adrenals. Acute passive congestion and parenchymatous degeneration of all organs. Meckel's diverticulum.

**Pathology of Respiratory Tract:** No foreign body in larynx or trachea. They contained a small amount of slightly blood-tinged muco-purulent exudate. As the bifurcation was reached the trachea and both main bronchi were found filled with a tenacious purulent exudate. No foreign body in left bronchus. In the right one about one-half to two-thirds of the split half of a peanut was found lodged against the bronchial mucosa. The peanut itself was covered with a thick pus; it was soft and easily fragmented. It lay in a shallow area of ulceration having a definitely raised border, situated nearer to the main bifurcation than to the first branch of the right bronchus. The entire right bronchial tree was filled with thick pus. The right lung measured 14 by 7 by 4 cm. Much larger than the left lung. Pleural adhesions over the base and between the lobes. The bronchi of all three lobes were dilated and filled with pus. The cut surfaces of all three lobes showed elevated, firm, yellowish areas with purulent centers. The picture was

that of a diffuse purulent bronchopneumonia with multiple abscesses. The left lung showed complete atelectasis of about one-third of the upper lobe. The large bronchi were filled with pus; the smaller ones were empty. No pneumonic areas were found. The pus in the larger left bronchi had evidently come from the right side, causing acute suffocation.

The microscopical examination of the right lung showed a sub-acute purulent lobular bronchopneumonia with multiple bronchiectases and bronchiectatic abscesses. In many of these abscesses small colonies of a ray fungus with hyaline clubs at the periphery of the colony were found—young actinomyces colonies. These were found especially in the older, larger bronchiectatic abscesses in the lower lobe. About these abscesses the lung tissue showed diffuse inflammation, congestion, edema, fibroblastic proliferation and thickening of the alveolar walls. On the left side the large bronchi were filled with pus without involvement of the bronchial walls. This lung showed only localized atelectasis, patches of acute emphysema, general congestion and edema.

The pathologic findings support the x-ray diagnosis.

**CASE VI.**—Mrs. R., age 53. *Clinics of Surgery and Internal Medicine.*

**Clinical History:** Entered the hospital October 31st, 1922. Principal complaint on entrance was weakness, projectile vomiting without nausea, frequency of urination, and loss of weight. Was well up to July 20, 1922, when she noted a marked sleepiness with profuse perspiration. She passed marked cloudy urine and complained of projectile vomiting. Lost sixty pounds in weight. There was also constipation,

thirst and polyuria. She has complained of difficulty in the vision of the right eye. She had scarlet fever, dropsy at the age of 3 years, "ague" at the age of 10, painful kidney trouble eight years ago, operated upon for "gall stones" eight years ago and appendectomy was done at the same time. She complained of some shortness of breath with some coughing. Menopause took place at 44. She shows jerking and twitching of the muscles with numbness of the fingers at times. No difficulty in walking. She had a 2 plus Wassermann on one examination and a plus-negative on a second examination. Spinal fluid was negative. Examination shows a large ventral hernia with a large mass in the lower abdomen. Eye examination showed marked neuroretinitis with angiosclerotic changes. There is a large amount of pus and albumin in the urine. Provisional diagnosis was pyo-nephrosis, acromegaly, possible lues, duodenal ulcer. Cystoscopic examination showed thick stringy pus coming from the left ureter. Her basal metabolism was plus 11. The patient's general condition in connection with the tremendous size of the pyonephrosis rendered surgical intervention extremely hazardous. She died suddenly on November 19th, 1922.

**X-Ray Examination:** Stereoscopic plates of the wrist showing the lower end of the radius and ulna, show no definite enlargement. The bone changes here do not correspond to an acromegaly. The plates of the fingers show definite enlargement of the bone which is a frequent accompaniment of acromegaly.

Stereoscopic plates of the sella turcica on this same case show moderate sized sella but with a distinct bony roof, constituting the so-called ring type of sella.

Stereoscopic plates of the left side of the skull show normal outline of the skull, normal development of the fron-



Fig. 16—Case V. Gross appearance of right lung. Diffuse purulent bronchopneumonia with multiple abscesses. Microscopical examination showed colonies of actinomyces in abscesses in lower lobe.



Fig. 17—Case VI. Plate of sella turcica shows completely roofed sella constituting the so-called ring sella. Evidence of bone proliferation posterior to the clinoidal processes.



Fig. 18—Case VI. Ring sella. Base of skull shows irregular exostoses and spur-like processes posteriorly, the large one on the right side posteriorly showing well.

tal sinuses and grooves of the meningeal vessels. The sella is distinctly shown to be of the ring type. Increase in the bone density of the section back of the posterior clinoidal processes. The appearance is not suggestive of an actual acromegalic condition.

**Pathological Report:** Autopsy 1383. A-64-AA. Mrs. A. R., age 53. Died 11-20-22 at 10:00 A. M. Autopsy 11-20-22, at 12:15 P. M.

**Clinical Diagnosis:** Left pyonephrosis. Acromegaly.

**Roentgenological Diagnosis:** Ring type of sella turcica. Moderate sized sella. Enlargement of phalanges. No positive signs of acromegaly.

**Pathological Diagnosis:** Acute fibrino-purulent peritonitis. Multiple duodenal peptic ulcers with perforation of one. Advanced chronic pyonephrosis on left side with ureteral calculus blocking ureter. Chronic cystitis. Marked fatty infiltration of liver. Fatty infiltration and fatty degenerative infiltration of heart. Sclerosis of endocardium. Ventral hernia with incarceration of omentum. Ring shaped sella. Cholesteatoma of pituitary. Dyspituitarism. Adenomatous goiter. Hypothyroidism. Obesity. Atrophy of frontal convolutions. Chronic leptomeningitis with congestion and edema. Osteophytes in dura mater. Hemosiderosis of spleen. Atherosclerosis of aorta with calcification of media. Mönckeberg's calcification of medium sized arteries. Congestion and edema of lungs. Old healed tubercle in right lung. Right-sided adhesive pleuritis. Chronic fibroid salpingitis. Prolapse of right tube. Old scar in posterior cul de sac. Chronic pelvic peritonitis.

This case presents a great variety of pathological conditions that may be brought into the following groups: *First—Constitutional.* An endocrinal case, as shown by conditions found in

the cranium, enlargement of sella, ring sella, formation of osteophytes in dura, basal exostoses, hypertrophy, fibrosis and multiple cholesteatomas of pituitary, hypothyroidism and obesity. *Facies stolid*, coarse, suggesting hypothyroidism. Low and disturbed mentality as shown by cerebral atrophy. The endocrinal condition is perhaps best interpreted as an early frustrate acromegaly, passing into the adposo-genitalis form of dyspituitarism. *Second—Gastro-intestinal.* The immediate cause of death was a generalized acute-fibrino-purulent peritonitis extending to diaphragmatic pleura, resulting from perforation of a chronic peptic duodenal ulcer. Ventral hernia with omental incarceration. *Third—Genito-urinary.* Chronic cystitis. Left-sided chronic pyonephrosis with blocking of left ureter by calculus. Chronic fibroid salpingitis. Prolapse of right tube. Old scar in posterior cul de sac. *Fourth—Premature atherosclerosis and calcification of arteries.*

Of these conditions the only ones recognized by roentgenological examination were the ring-shaped sella, the increased density of the neighboring bone, the spur-like exostosis posterior to the sella and the enlargement of the terminal phalanges which was not considered in itself diagnostic of acromegaly. The pathological diagnosis of an early acromegaly rests upon the enlargement of the sella and pituitary, the atypical osteogenesis about the sella, the exostoses of the base of the skull, the formation of characteristic osteophytes in the dura mater. The hypophysis was about twice the normal size. The anterior lobe was about evenly divided into two portions, one composed of eosinophile cells, the other of basophile. The chief cells were reduced in number and showed unusual vacuolation. The capsule was thickened. The intermediate lobe showed very little colloid in small spaces, with greatly

increased stroma. Attached to the intermediate lobe was a small cyst filled with laminated flattened cells (cholesteatoma). In the capsule of the posterior portion there were a number of small concentric masses of flattened cells (cholesteatoma pearls). The combination of hypertrophy of anterior lobe, atrophy of intermediate lobe and presence of multiple cholesteatomas form the basis for the pathological diagnosis of an early acromegaly (hyperpituitarism) passing into a condition of hypopituitarism, as the result of lowered function due to atrophy and fibrosis resulting from the pressure of the developing cholesteatomas.

The x-ray study of this case was limited to the bones of head and hands following the suggested clinical diagnosis of acromegaly. The patient, however, died of a peritonitis following the perforation of a duodenal ulcer, and had also a renal calculus obstructing the left ureter. X-ray study of these regions would have thrown additional light upon the nature of the conditions to be dealt with, and would have materially altered the clinical conception and procedures. This may be taken as an argument for the x-ray investigation of the body as a whole in all doubtful cases, instead, as is the rule, of confining that investigation to the region suggested by the clinician. The roentgenologist would then have an opportunity for more independent objective study of the case.

#### CONCLUSION

In conclusion, we believe that such correlative studies of x-ray plates and autopsy data are essential to the scientific advancement of roentgenologic interpretation. The x-ray plate is an objective fact; the interpretation is an intellectual process based upon knowledge and experience. The plate tells no lies, but the interpretation might do so.

## Diathermy, Its Field and Application

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PROFESSOR ZIMMERMAN, of Paris, has defined diathermy as "a form of thermo-therapy which utilizes electrical energy for the production of thermal effects in the depths of the tissues." Synonyms are: "endothermy", "thermo-penetration", "transthermy". Two forms of diathermy are recognized: "electrocoagu-

\*—Read Before the Joint Meeting of the Interstate Society of Radiology and Physiotherapy, and the Nebraska Radiological Society, Lincoln, Nebraska, May 14, 1923.

lation", which is a process by which tissues are heated beyond the physiological limit compatible with their life; and "medical diathermy," wherein tissues are heated only within physiological limits, i. e., without their resulting death. This paper will deal only with the latter phase, and the term "diathermy," unless otherwise specified, will refer to medical diathermy only.

It is a well-known fact that any electrical current when subjected to resistance in its circuit produces heat. The greater the resistance, the greater

the resulting heat. The body tissues offer a high resistance to the passage of an electrical current through them. Upon this principle diathermy is based. It is impossible, however, to use any kind of current for diathermy. A continuous, or galvanic, current cannot be utilized because of the pain produced by its application and because of the marked effects which take place at the points of application. A faradic current has the same drawbacks, and in addition causes violent muscular contractions.

In 1890 d'Arsonval, in repeating and elaborating the experiments of Ward, showed that if a current be reversed over five thousand times a second, the muscular contractions decrease in proportion to the increase in periodicity. Tesla, in 1891, utilized the rapid oscillatory discharges from Leyden jars, and passed large currents of high potential through the body without any painful or harmful effects. In the same year d'Arsonval passed three amperes through his own body without any sensation except that of heat. In 1896 he passed five hundred milliamperes through his patients, who noted distinct heating effects. In 1907 Nagelschmidt, at Dresden, demonstrated the "heating through" of tissues by high frequency currents and suggested their use in the treatment of diseases of the circulation and the joints.

The requisites for an effective diathermic current are as follows: The voltage must be high (from 10,000 to 50,000), the amperage low (from 100 to 3,000 ma.), and the oscillations very rapid (generally about 200,000 per second). Furthermore, the electrodes in contact with the body must be large enough to deliver the current to the tissues without undue heating, and they must be in good contact with the surface of the body.

Some of the more important effects of diathermy are:

1. Production of internal heat.
2. Stimulation of vasomotor nerves.
3. Stimulation of cellular activity and metabolism.
4. Marked analgesic properties.

Because of the shortness of this paper, these aspects will be but touched upon. To cover the ground thoroughly, considerable time would be required. Hence, a few remarks on each of these points will be offered, as a guide to further study.

The body tissues react to injury and infection by inflammation. In the case of injury without infection, inflammation increases metabolism and cellular activity in the injured region, thereby hastening repair. In the case of infection, inflammation serves several purposes. It increases metabolism; with increased metabolism comes increased temperature; with increased metabolism and temperature comes increased cellular activity. Most pathogenic organisms thrive best at body temperature, which is their optimum. As the temperature of the medium surrounding the bacteria is raised their vitality is lowered, their aggressiveness is less and their rate of propagation is retarded. Hence they are more susceptible to the defensive powers of the body. Vital processes are chemical

reactions or the result of them. Heat increases the rapidity of chemical reactions in the body cells. Within certain limits, with increased temperature, there is increased metabolism; with increased metabolism there is an increase in the intensity of the natural body defenses against invading infection and also greater rapidity of repair in injured tissues. Crile states: "In what way may heat exert its beneficial influence? Grant the premise that the natural defense of the organism against infection is made through the agency of phagocytosis and the chemical antagonism of the blood plasma, it becomes evident that in either case the defense is chemical. The fact that the defense is chemical gives at once a clue to the mechanism by which heat assists the defense against bacteria. It is probably because with the rise of each degree of temperature in any system, inorganic or biologic, the chemical activity is increased ten per cent, and the electric conductance two and one-half per cent. The increased chemical activity increases the chemical defense; the increased electrical conductance increases the metabolism. Therefore, we may suppose that heat accelerates the chemical defense as far as it involves chemical defense of the blood plasma, and that the heat aids also by increasing the total amount of blood in the inflamed part, thereby increasing the number of phagocytes. Moreover, heat assuages pain".

Fever is the natural method of increasing the heat of the body in times of stress. Let fever be produced how it will, by the body, it accomplishes these results:

1. Retards the propagation of bacteria.
2. Lowers their aggressiveness.
3. Lowers their resistance toward body defenses.
4. Stimulates body metabolism.
5. Stimulates body defenses thereby.

Diathermy is a "localized fever". This localized fever produces results which are largely confined to the area of application. The effects on bacteria and tissues are similar to those produced by natural fever. For localized conditions diathermy has several advantages over naturally produced fever: to-wit: it can be regulated as to area, height of temperature, and length of the time of application. With increased metabolism in a small area of the body, the tissues as a whole are not rapidly oxidized and the general resistance lowered as in natural fever of the general type. It is a fact, however, that the temperature of the body as a whole can be raised from one-half to four degrees by the lengthy application of diathermy. Saberton

states: "The artificial general pyrexia resulting from a diathermy treatment differs from ordinary pyrexia in that it is not produced by toxins circulating in the blood. After cessation of the treatment, the heat regulating mechanism quickly eliminates the excess of heat, and the temperature returns to normal. Dr. Albert C. Geyser points out that inflammation "is a physiological process, and is nature's attempt to cure, and that the principle factor in inflammation is the production of heat. Diathermy currents produce physiological heat within the tissues, and thereby assist nature to react and cure disease. If used within physiological limits, these currents are vitalizing and constructive."

In speaking of the effect of diathermy on the vasomotor system, F. de Kraft, in a Report of the Committee on High Frequency Currents, says: "the first effect of the great rapidity of the succeeding groups of oscillations is an intense heating of the surface of the body and of the blood. This, in turn, stimulates the great system of vasomotor nerves, resulting in peripheral dilatation of the blood vessels, and, at the same time, in the stimulation of the sweat-glands. It would appear that the sympathetic nervous system is stimulated in a most profound manner." De Kraft is further quoted by Lewis Jones: "Venous congestion, wherever present, is relieved, because of the marked activity of the circulation. Anemia of the splanchnic area ensues in the prolonged application of diathermy over large areas. When the action of the diathermic current has subsided, and the blood stream has returned to its normal channels, freshly oxygenated blood enters in greater abundance into the previously anemic and venously congested areas. The parts are placed in a better state of defense against the invasion of toxins and bacterial colonies." The stimulation of the vasomotor mechanism is not so much a direct effect by the current, as a secondary one resulting from the heating of the tissues.

Heat assuages pain. The application of a hot water bottle to an earache, pleuritic area, or inflamed appendix is an example familiar to all, as is the use of hot fomentations in the relief of pain in acute rheumatic fever. At times external heat, be it dry, moist, or radiant, gives relief when applied directly to, or over, the painful area. At times more marked relief is obtained by applying it over the reflex point.

External heat does not penetrate the tissues to any great extent—the blood stream quickly equalizes the difference in temperature between the point of contact of heat and the deeper tissues.



The action of diathermic heat is much more effective. The heat from this source is *endothermic*,—it is generated in the tissues themselves by their resistance to the diathermic current which is passing through them. The temperature is as high midway between the electrodes as directly beneath them. The operator is not confronted by the necessity of heating the surface of the body beyond the point of comfort to obtain a slight heating effect for a short distance beneath it, nor is he forced to prolong the application of warmth for one-half to three-quarters of an hour before effect is obtained. When diathermy is used, less than two minutes elapse before the sensation of heat is felt in the deep tissues, before it is perceived by the skin. This "internal heat" may be brought to any point desired and maintained there as long as desired. It may be "focused" in any direction, perpendicularly, obliquely or horizontally by proper arrangement of the electrodes. Where there is a relatively large amount of bone embedded in the tissues treated, diathermy has another advantage, for while the bony and other dense structures heat very slowly and require long application of a mild degree of warmth, when once heated through they dissipate their heat to the surrounding tissues very slowly, often requiring several hours to return to the temperature of the body. In this case the effect is quite prolonged and mild.

The indications for the application of diathermy are many. To go into the conditions which have been very markedly benefited by it would consume a vastly greater amount of time and space than is allotted this paper. Hence, they will be briefly dealt with. In a few words, the indications for the use of diathermy are as follows:

1. Wherever heat is necessary.
2. To increase local resistance.
3. To stimulate local metabolism and reparative process.
4. To lower bacterial aggressiveness and retard bacterial propagation.
5. To stimulate vasomotor mechanism.
6. To relieve venous congestion.
7. To relieve pain.
8. To stimulate cells and individual glands.

A few of the conditions in which diathermy has been particularly effective may be mentioned. Lobar pneumonia reacts in a startling way to diathermy if treatment is commenced in the early stages. If given in the state of engorgement, hepatization is prevented, and the disease goes on to rapid resolution. This mode of treating pneumonia was developed by Dr.

Harry E. Stewart, of Yale, and has since been used by a number of others with great success. Applications are made twice daily. The electrodes are placed over the affected lobe or lobes, anteriorly and posteriorly, with a graduated dosage of 500 to 2,500 ma. from fifteen to twenty minutes duration. Usually six to eight treatments suffice. After hepatization has taken place, although the stage of resolution is hastened, the course of the disease is not much shortened.

A high degree of success has been reported in the diathermic treatment of tuberculous kidneys. Cases carefully diagnosed by cystoscopic examination, and ureteral catheterization, and showing tubercle bacilli in the urine were entirely relieved of symptoms, and the patients gained rapidly in weight. The initial dosage was 500 ma. for twenty to thirty minutes, which was later increased to 1,000 ma. for ten minutes. The active electrodes were placed over the kidney region, with the indifferent electrode over the abdomen.

Pulmonary tuberculosis reacts rapidly to diathermy when the disease has not progressed far. In the incipient stages relief of symptoms is very rapid. If the temperature is over 100° F., diathermy should be used very cautiously. During the first few applications of diathermy there is a marked increase in the symptoms, the cough becomes more pronounced, the expectoration more profuse, the temperature higher, and symptoms of toxicity increased. Later these subside rapidly. This is a natural sequence, and, if the technique is correct and the patient is watched closely, no fear need be experienced. One of the modern authorities on diathermy, who has had vast experience with it, states that he has never seen a case that was not benefited by diathermy, when the technique was correct.

Bone and joint affections react well to this mode of treatment. Encouraging reports on tubercular processes in bones and joints are numerous. They state that healing and resolution take place rapidly as a result of its employment. In cases of ankylosis the tissues are softened and permit gradual restoration of motion, where the condition has not been of such long standing that the ankylosing tissues are infiltrated with bone itself.

After treatment by diathermy myocarditis often shows marked improvement on functional test. The power of sustaining an additional load is markedly increased after eight or ten applications of 500 to 1,000 ma. for ten to twenty minutes. The active electrode is placed over the myocardium and the indifferent electrode over the interscapular region.

The diathermic treatment of cancer is still in the experimental stage, but some promising results seem to have been demonstrated. Its use does not jeopardize the patient's safety or preclude the use of other measures. The New York State Cancer Laboratory states that all cancer cells die when subjected to a temperature of 116.6° F. for thirty minutes. Erlich determined that cancer tissue is no longer viable on transplantation after being maintained at 111.2° F. for thirty minutes. Dr. Albert C. Geyser states that: "From practical experience it has been shown that, when the entire malignant growth has been subjected to an increase of three degrees of temperature for sixty minutes daily, the physiology is markedly interfered with. Cachexia is prevented or removed; the tumor mass undergoes a retrograde metamorphosis, individual nodules soften; discharges lessen and lose their offensive odor." Neiswanger states: "A malignant growth is more dense and resisting than surrounding structures, with low vitality and a less direct, active circulation, and so is peculiarly calculated to accumulate and store heat." The writer offers no opinion on the matter, as his experience has not embraced this phase of diathermy.

#### APPLICATION

In the application of diathermy, the following factors must be considered:

1. The nature of the process to be treated.
2. The area of the process.
3. Its depth in the tissues.
4. The nature of the intervening tissues.
5. The result to be accomplished.

All these factors are of great importance, and unless cognizance is taken of them all, the maximum effect will not be obtained, and perhaps more damage than benefit will result.

The electrodes which supply the current must be good conductors, they should make a good contact with the body and they should be of such material as to allow moulding to the contour of the body where necessary. There are many kinds. The ones most used today are of block tin. Contact with block tin electrodes is made in one of two ways: a layer of gauze saturated with water or salt solution is placed between them and the skin; or the electrode and skin are well moistened with thick soap lather and the pad immediately applied. Another form is a moist composition pad, backed by a rubber plate. Where the surface of contact is very uneven, as about the shoulder, etc., an electrode of German silver mesh is used. This mesh is covered with thick soap lather before applying, and then weighted

down with a soft sandbag. Great care should be taken to see that contact is even throughout, and that the electrodes remain uniformly moist, as severe burns might result if the current were allowed to concentrate in a small area.

Electrodes should be placed so that the current traverses the shortest path through the tissue to be treated. The relative size of the electrodes is very important. When they are of equal size, the heat generated is uniform over both areas, since the current traverses the tissue perpendicularly. If, however, one of the electrodes is smaller, the current is converged thereby, and the current density on the smaller electrode is greater than upon the larger. When the electrodes are of equal size,

heating is apparent directly between them, with the highest point at the mathematical center of the crossing lines of force. When they are unequal, the intensity varies inversely as the ratio of the square inch covered, and the point of maximum heat moves, with the center of crossing lines of force, toward the smaller electrode. As the electrode becomes relatively smaller, the heat intensity becomes greater and its maximum approaches closer to the smaller, or "indifferent" electrode, as it is now called. When the intensity of the heat becomes great enough to coagulate the tissues, the process is known as "electrocoagulation". It is not wise to pass over 200 ma. through an active electrode two inches square, nor more than 1,000 ma. through one four inches square.

It will thus be seen that, by the judicious employment of suitable electrodes, the scope of diathermy is greatly widened. The point of greatest intensity of heat may be varied from the surface to a point midway in the part treated, and may be shifted to either side of the midpoint. It may be made uniform throughout or confined to one side. With a bifurcated conducting cord, more than one area may be heated to varying intensities, depending upon the relative sizes of the active electrodes.

In conclusion, let it be said that diathermy has proved to be a therapeutic agent of distinct value in medical practice, and, though it is still in its infancy, it has shown such promise that it behooves us all to develop it still further.

## Gastro-Intestinal Foci of Infection in Chronic Deforming Arthritis. Radiological Study of a Series of Cases\*

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A SEARCH of contemporary literature dealing with the etiology of chronic deforming arthritis reveals the fact that this condition is not a popular subject for discussion. This is doubtless due to the feeling of helplessness that exists in regard to the therapeutics of this disease. What profits it, we reason, to have discovered the etiology of this condition, when, by the time it presents itself for treatment irreparable damage has already been done? This may all be true. We may not hope to restore to normal the damaged tissues in the particular case under observation. But, if we know the etiology, may we not be instrumental in arresting the progress of the disease, and in preventing the onset of a similar condition in another individual, where that same causative factor is already in operation, with all its potentiality for deformity produced?

\*—Read at Annual Meeting of the Radiological Society of North America, Detroit, Dec. 6, 1922.

tion? It is with this prophylactic idea in mind that the writer has made a detailed investigation of the series of cases now being reported.

Under the term, chronic deforming arthritis, we include rheumatoid arthritis and osteoarthritis. Specifically excluded from this classification are

tuberculous arthritis, syphilitic arthritis, gonorrheal arthritis and gout.

Rheumatoid arthritis is an affection of the synovial membranes and of the soft tissues about the joints, and so is not usually susceptible of demonstration on the x-ray film. It has, as a rule, an acute and stormy onset, occurs in younger subjects, and simultaneously affects many joints, chiefly the smaller ones.

Osteo-arthritis is primarily a disease of the cartilage and bones, tending to the destruction of cartilage, and to the formation of osteophytic outgrowth at joint edges. Hence it gives a characteristic x-ray appearance. It usually has an insidious onset, occurs in older people, and affects a larger joint, as the hip or knee. A favorite site is the vertebral column, where it is known as spondylitis.

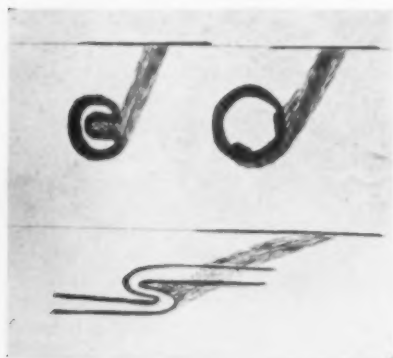
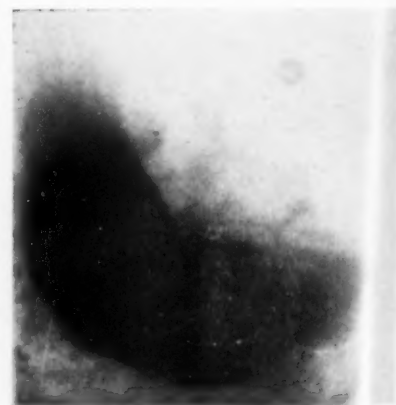


Fig. 1



Figs. 2 and 3—Mr. P., age 63. Complaint: Epigastric pain, spring and fall. History: Of 15 years duration. Diag-



nosis: Teeth, tonsils and antra negative. Duodenal ulcer with adhesions. Banded cecum and ascending colon. Spondylitis of lumbar vertebrae.

Chronic deforming arthritis is not by any means a rare condition. In this series a search was made through eight thousand consecutive case reports, with the discovery of two hundred and sixty cases of deforming arthritis.

In the search for etiology in these 260 cases, the writer was surprised to find that only 123 patients had been subjected to a complete gastro-intestinal x-ray examination. Of the cases examined previously to six months ago, only 93 out of a total of 222 had their gastro-intestinal tract explored radiologically. However, during the last six months this proportion has been changed. Out of 38 cases reported during this time, 30 had a complete gastro-intestinal examination.

Why this change in the point of attack, in searching out the cause of this condition? Formerly we were content, unless marked gastro-intestinal symptoms predominated, to localize the arthritic lesion, and to follow the beaten path in the search for foci in the teeth or tonsils or accessory sinuses. But, gradually, as the result of more intensive study of the gastro-intestinal tract, and a more extensive experience of the good results of conservative gastro-intestinal surgery, there has grown up in our mind a profound conviction of the extreme importance of gastro-intestinal lesions in all diseases that may be focal in their origin.

Analysis of findings in 123 cases of chronic deforming arthritis will be shown graphically in three tables.

TABLE 1. FREQUENCY AND CHRONICITY OF SYMPTOMS

1. Frequency:

- (a) Patients complained of arthritic symptoms in 70 per cent of the cases.



Fig. 4—Mr. P., age 22. Complaint: Pain in left hip and lower spine, worst when turning in bed. Pain in right hypochondrium. History: Attacks of pain in abdomen since childhood. Diagnosis: Teeth, tonsils and antra negative. Chronic cholecystitis. Duodenal adhesions. Bands of ileo-cecal region. Spondylitis, fourth lumbar vertebra.

Patients with arthritic lesions were free from arthritic symptoms in 29 per cent.

- (b) Patients complained of gastro-intestinal symptoms in 63 per cent of the cases.

2. Chronicity:

- (a) Average duration of arthritic symptoms, 17 years.

- (b) Average duration of gastro-intestinal symptoms:

Upper abdominal symptoms, 10 years.

Lower abdominal symptoms, 11 years.

From this table it is evident that in cases of chronic deforming arthritis the gastro-intestinal symptoms occur nearly as frequently as the arthritic symptoms. They also have a marked chronicity, although antedated considerably by the arthritic symptoms.

TABLE 2. LOCATION OF ARTHRITIC LESIONS

1. Rheumatoid arthritis, 14 cases.

2. Osteo-arthritis, 109 cases.

Distributed as follows:

Spondylitis . . . . . 40 cases

Knee Joint . . . . . 26 cases

Sacro-iliacs . . . . . 20 cases

Hip Joint . . . . . 20 cases

Shoulder Joint . . . . . 20 cases

Ankle Joint . . . . . 8 cases

Elbow Joint . . . . . 6 cases

Wrist Joint . . . . . 6 cases

(Many cases had more than one joint affection.)

TABLE 3—LOCATION OF LESIONS WHICH MAY BE REGARDED AS FOCI OF INFECTION

1. Gastro-intestinal lesions in 100 cases (81 per cent of all cases):

Constricting bands of colon (including terminal ileum) occurred:

Ileocecal . . . . . 47 times

Sigmoid . . . . . 10 times

Splenic Flexure . . . . . 8 times

Total . . . . . 65 times

Duodenal bands or membranes . . . . . 22 times

Chronic appendicitis . . . . . 22 times

Ileocecal incompetency . . . . . 12 times

Chronic cholecystitis . . . . . 17 times

Spasticity of colon . . . . . 10 times

Atonicity and redundancy of colons . . . . . 5 times

Duodenal ulcer . . . . . 3 times

Gastric ulcer . . . . . 3 times

2. Teeth, tonsils, and nasal accessory sinuses lesions in 73 cases (60 per cent of all cases), with infection occurring in

Teeth . . . . . 38 times

Tonsils . . . . . 42 times

Nasal accessory sinuses . . . . . 13 times

3. Genito-urinary lesions occurred in 18 cases (15 per cent of all cases).

Leaving out of consideration the lesions which occurred less frequently, it is evident that the important gastro-intestinal tract lesions which occur in chronic deforming arthritis are:

- (1) Constricting bands of the colon (including terminal ileum) . . . . . 65 cases

- (2) Constricting bands of duodenum . . . . . 22 cases

- (3) Chronic appendicitis . . . . . 22 cases

- (4) Chronic cholecystitis . . . . . 17 cases

With gastro-intestinal lesions demonstrable in 81 per cent of individuals suffering from chronic deforming arthritis, is it not a fair inference that gastro-intestinal pathology bears some etiological relation to chronic arthritis? What that relation is may be inferred by a process of deduction, but can not be definitely demonstrated except by animal experimentation.

It has been demonstrated experimentally that infective material from the tonsils, or the teeth, or the nasal accessory sinuses, can produce in ani-



Fig. 5—Mr. N., age 65. Complaint: Pain in right lower spine. Pain in right hip and thigh. Pain in neck. History: Pain complaint dates back 25 years. Diagnosis: Marked banding of ileo-cecal region. Osteo-arthritis right hip. Spondylitis, entire lumbar spine—all bridged.





Fig. 6—Mr. D., Age 24. Complaint: Complete rigidity of knees, ankles, hips, elbows. History: Acute onset of joint troubles eight years ago following severe attack of jaundice and dysentery, in bed six months. Progressive involvement of large joints, until now all are ankylosed. Diagnosis: Teeth, tonsils, and antra negative. Duodenal adhesions. Osteo-arthritis, with ankylosis of all large joints.



Fig. 7—Mr. McN., age 50. Complaint: Epigastric pain lasting two or three days and occurring every two or three months. Burning pain in right lumbar region. Pain in back when turning in bed. History: All complaints date back years. Abscessed teeth removed four years ago. Diagnosis: Duodenal ulcer and duodenal adhesions. Chronic appendix. Spondylitis of second and fifth lumbar vertebra.



mals gall-bladder disease or appendicitis, or, by a lengthened process of laboratory culture and subculture, arthritic changes. So that it is generally admitted that infective processes in teeth or tonsils or nasal accessory sinuses are rightly regarded as possible

foci for the production of gastro-intestinal and arthritic lesions.

A laudable field of activity for some enterprising bacteriologist would be the attempt to produce arthritic changes in animals by injecting pure cultures of bacteria recovered from not only gall-bladders and appendices, but from under severed duodenal and colonic bands.

In our opinion, based on close observation of a considerable series of cases, the production of chronic arthritis is dependent upon foci in the gastro-intestinal tract even more frequently than upon those found in tonsils, or teeth, or nasal accessory sinuses.

Further we are convinced that where the two classes of lesions co-exist in any individual suffering from chronic arthritis, it will be of little value to remove the focus in teeth or tonsils or sinuses, while leaving untouched the gastro-intestinal lesion.

Whether or not one considers that the gastro-intestinal lesion is responsible for any contribution of bacteria to the arthritic process, one must certainly admit that the lesion, related, as it is, to the focus in teeth or tonsils or sinuses, must play a great part in preventing the establishment of immunity against the infecting organism. To expect nature to establish such im-

munity as will lead to the arrest of the arthritic process, in the presence of an untreated intestinal focus, is certainly contrary to all that we know of the modus operandi of the body defenses.



Fig. 8—Mr. C., age 57. Complaint: Pain left knee. History: Dates back years. Diagnosis: Teeth, tonsils and sinuses negative. Bands of cecum and sigmoid. Osteo arthritis. Left knee joint.



Fig. 9—Miss D., age 40. Complaint: Pain in right lumbar region and in right hip joint. Gas in bowels. Belching of gas. History: Pain dates back one year. Abscessed tooth removed one year ago. Diagnosis: Chronic appendix. Bands ileo cecal region. Spondylitis of fifth lumbar vertebra.

# GASTRO-INTESTINAL FOCI OF INFECTION IN CHRONIC DEFORMING ARTHRITIS—CARTER

We presume that all will agree with what has just been stated regarding gastro-intestinal lesions as possible foci of infection, if by gastro-intestinal lesions we mean only chronic gall-bladders and chronic appendices. To thus restrict the term, and so leave out of consideration, in diagnosis and treatment, the constricting bands of the small and large bowels, is, we are convinced, an omission of the gravest moment. In this series these bands were found more than twice as frequently as were chronic gall-bladders and appendices. We regard their investigation and treatment as of the greatest importance. From a somewhat extensive experience in their diagnosis, and in demonstrating their association with the production of symptoms, by observing the relief obtained

after their surgical removal, we are convinced that their pathological significance is of the first order.

The subject of intestinal bands and adhesions has given rise to a great deal of controversy. Some claim that they are always pathological and their removal is productive of good. Others hold that they are largely developmental and should not be touched, and that in so far as they are pathological the results of surgical interference are neither beneficial nor permanent.

This whole controversy arises largely out of a confusion of terms. In this, as in most controversies, the opposing schools are not referring to the same thing. The surgeon-optimist of the intestinal tract is thinking of intestinal bands, the surgeon-pessimist is thinking of intestinal adhesions. The two lesions are hopelessly confused in the literature, and yet they are conditions which have almost nothing in common.

It should be clearly understood that intestinal bands are *not* intestinal adhesions. Bands and adhesions are distinct pathological entities, definitely capable of differentiation by the radiologist. Bands are adventitious veils or membranes (Fig. 1). They take their fixed point from some place on the parietal or visceral peritoneum and pass out across the free border of the bowel to a greater or lesser distance. In the process of organization and contraction they cause the bowel to infold on itself longitudinally, with resulting narrowing of calibre, or transversely with the production of angulation. This is shown graphically in Figure 1. This constriction or angulation, as the case may be, not only produces stasis, with resultant toxemia, but also reflexly disturbs the

innervation and upsets the normal equilibrium of the affected area.

Intestinal adhesions, on the other hand, are always the result of a local peritonitis, caused by injury either mechanical or chemical or bacterial.

Bands are quite easily removed. Their removal gives relief from symptoms, and they do not frequently recur. Adhesions, on the other hand, are difficult of removal, are not always incompatible with good function, and tend to recur after their removal.

In this report we are dealing with intestinal bands and *not* intestinal adhesions. Out of the 123 cases, 87 had constricting bands of the large and small intestines.

Adhesions, that is, one peritoneal surface glued to another, are comparatively rare in connection with the large bowel except in gynecological cases. Where they are not due to a generalized plastic peritonitis (e. g., tuberculous peritonitis) or an acute local peritonitis (e. g., appendiceal abscess) they are nearly always post-operative—the result of poor surgical technique.

Bands on the other hand, are very frequent, as this series shows. That their radiological diagnosis is con-



Fig. 10—Mr. McK., age 60. Complaint: Pain in right shoulder, following injury one year ago. Nausea with chills at times. History: Shoulder pain one year. Nausea and chills since childhood. Diagnosis: Teeth infection. Non-rotated cecum. Osteo-arthritis right shoulder.



Fig. 11—Mr. McD., age 22. Complaint: Left lumbar region pain, since injury. History: Notices spine bending sideways. Duration of symptoms one year. Diagnosis: Tonsils infected. Sigmoid banding. Spondylitis of fourth and fifth lumbar vertebra with sacralization.



Fig. 12—Mr. G., age 42. Complaint: Pain in right knee. Rheumatoid swelling of many small joints. History: Extends over years. Diagnosis: Chronic cholecystitis. Chronic appendicitis. Ankylosis of patella.



Fig. 13—Mr. B., age 59. Complaint: Pain in lumbar region and right hip. Epigastric distress. History: Lumbago for twelve years. Diagnosis: Infected teeth. Banded ascending colon, with cecal dilation. Spondylitis of third lumbar vertebra.

firmed operatively, that they are productive of symptoms, that these symptoms are relieved by their removal, the following statistics will demonstrate.

In a former paper<sup>1</sup> I showed that the radiological diagnosis of intestinal bands was confirmed in every case in a series of one hundred and thirty-five operations.

In a paper read by my colleague, Dr. Bigelow<sup>2</sup> the results of surgical removal of bands in a series of cases are reported. Questionnaires were returned by one hundred and five patients who had been operated for removal of bands of the large intestine or terminal ileum. The general symptoms, for the relief of which the operations had been done, as reported by the patients, were completely relieved in 37 per cent of the cases, much improved in 45 per cent, and somewhat improved in 15 per cent. Any surgical procedure which produces beneficial results in 97 per cent of operated cases should challenge the attention of those interested in the treatment of similar conditions.

Another colleague, Dr. Cromarty,<sup>3</sup> has analyzed the results of 40 consecutive operations on duodenal bands or

membranes. These were all diagnosed by the radiologist and their diagnosis confirmed at operation. All had been subjected to prolonged medical treatment without improvement. The main symptoms complained of were epigastric pain and localized epigastric tenderness, nausea, and, to a lesser degree, eructations of gas. Questionnaires, returned by forty operative patients, showed relief from pain and tenderness in 88 per cent of the cases, relief from nausea in 80 per cent and from gas eructations in 55 per cent.

These statistics with their story of the reliability of the radiological diagnosis of intestinal bands, of the ability of these bands to produce symptoms, and of the possibility of relief from these symptoms by the correct surgical treatment of these bands, surely justifies the radiologist in an enthusiastic advocacy of the search for intestinal pathology as an etiological factor in chronic diseases.

The frequency of the occurrence of such intestinal bands, and of chronic appendicitis and cholecystitis in individuals suffering from chronic deforming arthritis certainly justifies one in coming to the conclusion expressed by

Mutch.<sup>4</sup> In a paper contributed to the *Lancet* he summarizes the outlook on chronic arthritis in these words: "The condition of the alimentary tract dominates the outlook in rheumatoid and osteo-arthritis."

A few case histories are appended. They are not selected cases, but picked at random. The illustrations show the arthritic lesion in each case. Where colon banding was the associated intestinal lesion no attempt has been made to illustrate it, since banding of the large bowel is diagnosed fluoroscopically and is not usually susceptible of demonstration on the radiograph.

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## Ultra-Violet Radiation in Malignancy\*

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ULTRA-VIOLET radiation is not a fitting agent for the immediate treatment of malignancy; but it occasions in the body certain well defined physiologic responses that, indirectly, assist materially in the better handling of these cases when used as an adjunct to whatever means the therapist may select in attacking the growth itself.

For the sake of convenience it is adequate to group the uses of ultraviolet radiation in these cases as, (1) remedial and (2) corrective.

#### REMEDIAL INDICATIONS

1. *Calcium Metabolism.* Clowes and Frisbie investigated the inorganic constituents of tumors and found that rapidly growing tumors contain much potassium and little calcium; and, contrariwise, slowly growing tumors are rich in calcium and low in potassium. There appears to be a ratio between the potassium and calcium content of a tumor that is most favorable to rapid growth; and this ratio is expressed as

$$\frac{K}{Ca} = \frac{2}{1} \text{ or } \frac{3}{2}$$

\*—Received for publication July 10, 1923.

Beebe's work, supported by the findings of Clowes and Frisbie, is confirmatory of the observation that in proportion as the calcium content of a tumor increases, the growth rate of the tumor diminishes.

Experimentally, Goldzieher appears to have established that the injection of calcium salts into mice decreases their susceptibility to inoculated cancer; and Cramer, on exposing cancer cells to calcium salts, found their growth capacity when inoculated to be reduced.

Cancer cachexia, which is not considered to be different from cachexia attending other conditions, shows a high elimination of mineral salts such as is found in tuberculosis, and called "demineralization" by Robin. And the blood in cancer contains less calcium than normal, which results in the tendency to osteoporosis (Goldzieher) and to the deposition of the mineral in the epithelium of the kidney (Cramer).

From all of which it is reasonable to ascribe to calcium an inhibiting action against

1. The virulency of the cancerous growth itself; and,

2. The trend to metastatic spread when the tissue fluids are normal or high in calcium.

There is, obviously, much ground for the therapeutic desirability of keeping a high calcium content in the blood in the treatment of malignancy; and this situation, as is well established, may be simply and efficiently occasioned through the use of biologic or air-cooled ultraviolet radiation. The studies that have led to realizing the calcium raising effect of biologic ultraviolet radiation are due to Hess, followed by Tisdall. They have been satisfactorily ascertained in the case of rickets, upon which subject many prominent investigators have amply reported.

One indication for the use of biologic ultraviolet radiation in malignancy, therefore, centers around the role played by calcium and the ability to keep this mineral at a high level in consequence of the action of the energy on the body.

2. *Iron Metabolism.* There is always, in malignancy, a secondary anemia due to cachexia which expresses a general decrease in all the elements of the blood, both cellular and chemical.



Nothing very definite is known about the effect of ultraviolet on the blood; though the consensus of many observers seems to incline to the positive evidence that there is a decrease in the red count and in the percentage of hemoglobin in the dark, and an increase in the light, especially under biologic ultraviolet radiation, after long exposures in the normal individual. In those showing a secondary anemia, however, ultraviolet energy raises the cell and hemoglobin content much more rapidly than in the normal.

In my belief, the anemia of malignancy is improved by ultraviolet radiation not because of any immediate bettering of the iron metabolism (such as the change in the calcium metabolism that follows ultraviolet irradiations), but rather because of the general systemic uplift that these biologic radiations impart; although, in chlorosis, ultraviolet acts favorably and promptly affecting the iron metabolism and reorganizing the endocrine balance of the patient.

Following general bodily exposures to ultraviolet energy, the red cell count remains, at first, stationary; but the hemoglobin rather steadily increases. Later, when the hemoglobin has been raised 10 to 15 per cent, the cells and hemoglobin augment simultaneously. Nothing is observed in the cell or hemoglobin content until after twelve or fifteen bodily irradiations have been given.

So that a second indication for the use of ultraviolet rests in the tendency that this energy exhibits in increasing the hemoglobin and red cell count, thereby correcting, somewhat, the anemia.

3. *Leucocytes.* Under radiotherapy, those cases of malignancy seem to do best when the leucocytes are normal or above normal in number. This casual observation has been confirmed by the opinion of radiotherapists with whom it is my privilege to consult.

Now, white blood cells, as distinguished from red blood cells, readily respond to short exposures of any radiation (such as sunlight, ultraviolet, x-ray, heat). Of these radiations, the response elicited by ultra-violet is less striking than that incident to any other radiation; but all authentic reports agree in the conclusion that this actinic energy stimulates a leucocytosis in men and in animals.

Janet Clark, in her researches, found that lymphocytosis is induced by ultraviolet wave-lengths shorter than 3300 Angstrom units. Nothing can be advanced that explains the mechanism underlying the leucocytic changes produced by biologic ultraviolet radiation; but, as Janet Clark

mentions, presumably the lymphocyte-forming organs are stimulated to greater activity through some photochemical change precipitated by the rays.

In malignancy, as in uncomplicated tuberculosis, the air-cooled ultraviolet radiation appears to strike a polynuclear instead of a lymphocytic response. It is difficult to determine this point because of the interference that is subscribed by the use of radium or x-rays at the same time. Tumors removed by diathermic surgery offer the clearest study; and in several cases of this sort, when air-cooled ultraviolet was also used, the cytolytic changes effected the polynuclear cells, whose number increased.

A third indication for the use of ultraviolet in the adjunct treatment of malignancy is explained by the polynuclear increase that the radiation may engender in these patients.

4. *General Metabolic Effect.* Ultraviolet exerts an influence on body metabolism. This is experimentally indicated by

1. Changes in the quantity of expired  $\text{CO}_2$ ;
2. Changes in the rate and depth of respiration;
3. Increased rate of growth in light as compared to the growth in darkness.

There is much to show that the cachexia of cancer produces metabolic changes not unlike those that accompany fever. This is true for the nitrogen metabolism which, in cancer, behaves like the nitrogen metabolism in tuberculosis.

As was discussed in the *Journal of Radiology* for November, 1922, ultraviolet energy acts as a metabolic pace-maker; so that its influence in adjusting and equilibrating perverted metabolic processes, lends much to the symptomatic treatment of cancer.

Numerous investigators report a decreased alkalinity in the blood in cancer; others, by means of H-ion titrations, report the reverse. Of twelve specimens taken from cancer patients, my own H-ion titrations seemed to point to an existing acidosis, contrary to the findings of Menten; but these results cannot be considered as conclusive, because of the imperfect determination owing to the colloidal dialysing technique personally employed.

For the present, the exact data on the effect of ultraviolet energy on metabolism must remain unpublished until the subject receives more study and control experimentation; but the evidence so far at hand, points to the general acceleration of all metabolic processes that, in cancer and in cachexia of whatever origin, are usually suppressed by the toxic influence of

the invasion, replacing exogenous by endogenous metabolism.

## 2. CORRECTIVE INDICATIONS

1. *Radiotherapeutic Trauma.* Should telangiectases appear consequent to radium or deep roentgenotherapy, the ultraviolet energy finds valuable application. Prolonged exposures, possibly even to the point of blistering, and sometimes best when applied under compression from a large quartz lens, very usually remedy telangiectatic pathology.

Ulcers brought on by x-ray or radium exposure, like ulcers from any cause save syphilis, respond best to ultraviolet energy. Chronic sluggish ulceration in which epithelium refuses to grow, can be treated with hopefulness, as is illustrated by the following case, taken from the *Southern Medical Journal*, and reported by Dr. Jack W. Jones:

"D. B., a male, age 12, referred by Dr. Hoke, came into my office January 12, 1922, and was entered with a diagnosis of dermatitis traumatica. The following history was obtained: Eight years previously he developed an osteomyelitis in the left leg. He was operated upon several times by different physicians and treated in various ways, until sixteen months before presentation, when he came to Dr. Hoke, who operated upon him for the same condition. Seven months after operation he was sent home with the leg entirely healed. It remained in this condition for about seven months and the boy was apparently leading the normal life of a school boy.

"Following a slight injury, a sore developed on the old scar tissue and despite treatment two more formed. All of them refused to heal under the usual type of treatment. When I examined him, there were three lesions over the tibia, extending from the middle of the lower left leg to the ankle. These lesions were about the size of a quarter. The lower one was draining some pus. The upper lesions showed unhealthy granulations, a bluish color and numerous crusts scattered around them. The skin and scar tissue around them were very thin and resembled parchment. X-rays of this leg by Dr. Hoke showed nothing pathological. Routine laboratory examinations were negative. The boy's general condition was good. He was started on daily radiation with the ultraviolet rays, ranging from one and one-half minutes the first day to eighteen minutes during the latter part of treatment, with a fifteen-inch distance. The lesions be-

gan to show improvement after the fourth day. After the first ten days, treatment was instituted every second day. On the twenty-eighth day, the lesions were healed. The epithelium covering the scar tissue was firm and looked as healthy as the skin on the other part of the leg. The leg showed a good coat of tan from treatment and the bluish-red color had disappeared. The patient was discharged on the thirtieth day and advised to expose the leg one hour each day to the sun's rays. From last reports the condition has remained well and the skin seems to have regained its healthy tone."

A consideration in the ultraviolet treatment of ulcerated skin surfaces has to do with the dosage of radiation used. Customarily, each actinic exposure following the first is increased in order to compensate for the diminished susceptibility imparted by the erythema and tanning. In ulcerated surfaces, where the pigment layer of the skin is missing, the protection is not established; and the newly formed granulations should not be rayed for too long a time, as this leads to their destruction rather than to their stimulation. The subject is discussed more completely in an article submitted to the American Journal of Radiology and Electrotherapeutics.

Becker, at Frankfort, claimed in 1915 that ultraviolet radiation increases the tolerance of the skin to x-ray dosage. This has never been conclusively proved. All of the foreign and, recently, American literature that has been carefully studied convinces me that the authors of these statements have applied x-ray doses to the skin that are far below the erythema dose; that they have not taken into consideration the unusual variations in skin sensitivity exhibited by various individuals, and by the same individual when treated with variously filtered x-rays; that they have used x-rays in unprecedented fashions, such as for "ionic" effects, or for conditions that are speedily influenced, and therefore far from the more accurate (though still imperfect) estimate of x-ray erythema. As far as personal observations on my own skin are concerned, nine ultraviolet tanned and nine untanned discs<sup>10</sup> subjected to x-ray became equally erythemic, the heavy ultraviolet pigmentation failing entirely to prevent the x-ray erythema from arising as compared to the untreated area.

It seems to me imperative that judgment on this matter be somewhat reserved. Enthusiasm in the belief of the premise, if unfounded, and there

is certainly nothing yet definite or plausible in the way of proof, may lead to quite serious consequences.

The treatment of x-ray and radium dermatitis has been discussed elsewhere,<sup>11</sup> from which study the following summary is reproduced:

1. "Ultraviolet energy may be used as a preventive against the erythema produced under x-ray exposures.
2. "Ultraviolet energy, through its cellular regenerative force, will assist in the reconstruction of indolent x-ray ulcers.
3. "In the treatment of acute and chronic x-ray and radium dermatitis the biotic qualities of the air-cooled and the abiotic qualities of the water-cooled equipment should be clearly and judiciously employed if best results are to be achieved.
4. "It is neither proved nor disproved that the application of ultraviolet energy, before or after an x-ray exposure, will prevent the damage to the cellular structures in depths greater than 75 or 100 microns. Aborting x-ray erythema through the use of ultraviolet energy must not be considered a corrective for the deeper tissue changes induced by x-ray and radium trauma.
5. "Air cooled or biotic ultraviolet energy is useful in every form of acute x-ray dermatitis; and in raising tissue resistance in chronic x-ray dermatitis. Water-cooled or abiotic ultraviolet energy, owing to its desquamative capacity, does much to relieve the prominent acanthosis that forms an inherent part of chronic x-ray and radium skin changes."

#### METHODS

For the remedial indications listed, the air-cooled or biologic ultraviolet energy is best suited. It is given "generally", by exposing the entire front and back of the body, to the ray. For the best effects, the operating voltage of the Uviarc should be 70. The distance from tube to skin, 40 inches. A stimulative reaction is sufficient, and is produced, under the operating conditions just mentioned, in the following time, depending upon the age, sex and endocrine type of the patient:

#### GENERAL OR SYSTEMIC IRRADIATION

Air-cooled lamp; volts, 70; tube-skin distance, 40 inches; central ray strikes at right angles; average approximate exposure values, in seconds:

#### ERYTHEMA

	Stimulative	
	Light	Dark
Female adults...	50	60
Male adults.....	60	90

The eyes must be protected, by keeping them closed, or by the use of goggles. The exposures should be given daily, each exposure being increased in time in amount equal to the first exposure.

For telangiectases, the area involved is heavily rayed, at least to the point of regenerative erythema, and possibly even to the extent of blistering. Sometimes, quartz lens compression appears to assist materially, as Casenberg correctly remarks. The air-cooled lamp had best be operated between 80 and 90 volts, with a tube-skin distance of 10 inches. The time for the initial raying is, approximately:

#### INTENSIVE IRRADIATION

Air-cooled lamp: Volts 80 to 90; tube-skin distance, 10 inches; central ray strikes surface at right angles; average approximate exposure values, in seconds.

#### ERYTHEMA

	Regenerative		Desquamative	
	Light	Dark	Light	Dark
Female adults	20	30	40	60
Male adults.	30	40	60	75

When the compression method, as suggested by Casenberg, is used, the water cooled lamp, furnishing a more powerful abiotic radiation, is utilized. A suitable quartz lens is fitted to the lamp, and with the uviarc operating between 50 and 65 volts, the telangiectatic area is attacked by firmly compressing each portion. The object of the compression is to exsanguinate the blood capillaries that form an effective barrier to the radiation. From 1 to 3 minutes is sufficient exposure time over each compressed area.

#### SUMMARY

Air cooled ultra violet radiation

1. Increases calcium metabolism, which influences the virulency of existing toxicity and renders metastasis less likely.
2. Tends to increase iron, and thereby corrects the secondary anemia.
3. Produces a polynuclear leucocytosis in cases of malignancy; considered a valuable prognostic in the treatment of these patients.
4. Readjusts the general metabolic activity, thereby checking the cachexia.
5. Corrects telangiectasis.
6. Is helpful in radium or x-ray burns.

7. Does not, apparently, materially increase the skin tolerance to x-ray erythema sufficiently, if at all, to be of therapeutic aid.

Because of these qualities, the biologic ultraviolet radiation is useful as an adjunct in the treatment of malignancy.

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# EDITORIAL

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### American College of Radiology and Physiotherapy

AS A sufficient guaranty that the concomitant trust imposed in them by the recognition accorded the American College of Radiology and Physiotherapy by the American Medical Association, the officers of the former can only promise a vigorous and prudent administration of its affairs and offer as a pledge of performance their reputation as members of the American Medical Association and their standing as citizens in the community in which they respectively live.

For the benefit of those who may not have enjoyed the privilege of reading the November issue of the American Medical Association Bulletin—which be it known is the official journal of the House of Delegates of the Association—the comment of that body is quoted at length:

#### "ANOTHER AMERICAN COLLEGE

"The American College of Radiology and Physiotherapy was organized at Omaha, September 18, 1923. According to the Journal of Radiology, the new college is modeled after the American College of Physicians and Surgeons, and 'is the logical result of the action taken by the American Medical Association at its latest annual meeting in San Francisco.' The action referred to was the adoption by the House of Delegates of the report of the Reference Committee on Sections and Section Work, containing the following:

"1. We especially endorse the recommendation that no changes be made in the number of sections of the Scientific Assembly. This opinion already has the approval of the House of Delegates, as expressed at the St. Louis session.

"2. We feel, however, that the Association should recognize the increasing importance of special medical activities, such as radiology, physiotherapy, and occupational therapy; and to that end we wish to express our approval of that portion of the resolution offered by Dr. Van Zwaluwenburg, which provides that, wherever possible, every section program should contain at least one paper on a subject pertaining to some other specialty of particular interest and importance to members of the section, and your committee makes such recommendation.

"In view of the fact that laymen are attempting to practice radiology, we recommend that the American Medical Association recognize the science of radiology as an integral part of medicine and surgery.

"The Journal of Radiology presents a list of twenty-six organizations that have already received recognition by the American College of Radiology and Physiotherapy, seven of which are national in scope, while seven appear to be district or sectional bodies, eight state societies, and four strictly local organizations. Similar recognition is to be accorded other like organizations on the presentation of appropriate credentials.

"Samuel Beresford Childs, M.D., Denver, is President, and Roy W. Fouts, M.D., Omaha, is Secretary of the newly organized college."

It is the desire of the founders of the College, as well as its officers, in this early stage of its existence, to express the hope that the utmost spirit of harmony and cooperation shall exist between the American Medical Association, the American College of Physicians, the American College of Surgeons, and all other reputable medical organizations, and the American College of Radiology and Physiotherapy.

For the purpose of insuring this harmonious conduct of its affairs, one of the requirements of membership in the American College of Radiology and Physiotherapy is membership in good standing in the local county medical society, and it is very gratifying indeed that applications from medical men of this high character are being received almost daily.

Probably the greatest hindrance toward the progress of the sciences of radiology and physiotherapy in the past has been the apparent blinking of eyes over the question as to who should and who should not be recognized as competent to practice in these phases of medical science.

For once and all the American College of Radiology and Physiotherapy states the fact fearlessly and in uncompromising manner that no serious objection can be raised to the view that no man or woman can practice these integral parts of medical science without proper and solid grounding in medical science itself. The logical corollary of this proposition is that it is the bounden duty of those reputable practitioners of these phases of medical science to raise the standards of their profession as thus specialized and to defend them openly before the world in conformity with the ethics of the great medical profession of which they are a part.

For this reason, the American College of Radiology and Physiotherapy will espouse only those tenets of, and developments in, these phases of medical practice which have sound relation to the science of medicine, and have for their object the prevention and relief of human suffering.

In the pursuit of these ideals, it is earnestly believed that the American College of Radiology and Physiotherapy can do much toward elevating and forwarding these phases of medical science, and eliminating much of the disappointment and dissatisfaction of many of the practitioners in these specialties over the fact that their labors are not as comprehensively recognized as they feel they rightfully should be. The officers of the College feel that the greatest curative for this condition can be found in the improvement of method and precept by which the men engaged in these specialties measure their conduct with their fellow practitioners and the public, and to that end unswervingly is the American College of Radiology and Physiotherapy dedicated.

With this statement of purpose of the College and allegiance to all recognized reputable medical organizations, it is hoped that coordination of effort will follow unequivocally because there is much work to be done.

### Necessity of Cooperation Between Radiologist and Physiotherapist and Surgeon

**R**ADIOLOGY and physiotherapy are two distinct entities, therefore I shall discuss them separately in their relationship to surgery.

The science of radiology has become, I should say, next to that of sepsis and antisepsis, the greatest aid to the surgeon of all the allied medical sciences. Diagnosis and treatment of surgical conditions that come under the scope of radiology have become so dependent on the x-ray that it is hard to conceive how the surgeons of past generations managed their work so well as they did. The fact then is self-evident that the best results can only be obtained by the very closest cooperation between surgeon and radiologist.

How can this close cooperation be thus accomplished? First of all the radiologist must have a properly equipped laboratory to produce accurate radiographs of the various pathological processes. Just as important as this is his ability to correctly interpret the radiograph so reproduced. Consequently his knowledge of pathological conditions that can be shown by the x-ray must necessarily be extensive and complete.

Among the ~~most important~~ pathological processes the radiologist is called upon to examine are fractures, dislocations, foreign bodies, calcareous deposits, bone diseases, bone tumors, joint diseases, empyema, lung abscesses, gastrointestinal surgical conditions, genito-urinary surgical conditions, deformities, anomalies, sinuses, and alveolar abscesses.

It is just as important for the surgeon to possess accurate knowledge of pathological processes that can be shown by the x-ray and to be able to recognize them in the radiographs. If he does he should have the advantage over the radiologist in that he has greater knowledge, as a rule, of the case history which is often very helpful in determining the correct diagnosis. Having this knowledge he can be helpful to the radiologist by giving specific suggestions regarding the pathological process that is to be determined. For example, let us suppose that we have a suspected case of lumbo-sacral arthritis which may show symptoms leading to suspect stone or stricture of the ureter, appendicitis, or tub-ovarian disease. The surgeon in such a case should request a stereoscopic radiograph of the lumbo-sacral region, together with an enumeration of the pathological conditions which he has under consideration. Without a good stereoscopic picture of this portion of the skeleton it is risky to venture a diagnosis or what is worse, report negative findings, unless the process is well advanced. Such a case has only recently come under my observation after going through the hands of many doctors, including surgeons, urologists, and radiologists, undiagnosed and consequently variously and improperly treated.

While on this point let me urge stereoscopic pictures of all difficult joint cases. You will be able with a good stereoscopic radiograph to pick up detailed joint pathology where it might not even be suspected in a flat plate. A good example of this is the erosion of the head of the humerus that is often seen in chronic subacromial bursitis. Likewise, stereoscopic pictures of the knee joint will show derangements in structure such as injuries to the spine of the tibia, and arthritic changes that can oftentimes only be suspected in a flat plate.

Accurate diagnosis of the various bone growths and diseases are often dependent on the case history; so let me urge here again that the surgeon and radiologist get together be-

fore making a decision that is so often of very great concern to the patient.

In the management of ambulatory fractures I would suggest that the radiologist be equipped with proper facilities for handling cases that require an anaesthetic for reduction and also an immediate x-ray examination. The latter should be made either fluoroscopically or by films while the patient is still under anaesthesia, so that if the reduction is not correct it can be corrected without the necessity of another anaesthetic. There is nothing quite so satisfactory, I believe, in the treatment of fractures as to do the job at one sitting.

The numerous vague indefinite requests often sent in to the radiologist by the referring physician are a source of worry, a waste of time and often result in a loss in accuracy. Patients are sent to the radiologist, for example, with simply a request for an x-ray of the leg, or arm, or back, or what-not. In all probability if it is an arm the patient will be wearing a splint or cast or a bandage. The radiologist is at once perplexed and often bewildered to know just what part of the arm he should radiograph to show the presence or absence of the pathology suspected. He may get a little information from the patient as to what part of the bone is injured or diseased, but this information is often misleading or incorrect. He is not allowed to remove the splint or dressing to determine accurately for himself, and so must guess more or less as to the location of the injury or disease. If he guesses right, "Eureka, all is well," but if he does not, he has to try another region or else call up the referring surgeon for the desired information. Such a predicament can easily be avoided if the surgeon sending in the case will only take the time to write out specific instructions to the radiologist. For example:

"Dr. Roentgen:—

"I am sending you Mr. John Doe, who has a fracture of the ulna at the junction of the upper and middle thirds. Please x-ray same, taking antero-posterior and lateral views and report findings by telephone."

The case can be examined immediately without any information from the patient, and the surgeon supplied with the desired information without any delay whatsoever.

While on this point I cannot urge too strongly the necessity for antero-posterior and lateral views of all fractures of the long bones. So often we see a fracture apparently in perfect position and alignment in one view and the opposite view shows the fragments completely offset and perhaps overlapping.

Similar errors in fractures in the region of joints can be detected by stereoscopic radiographs. This is especially important in fractures of the neck of the femur. A single plate may show the fracture apparently in perfect position whereas a stereoscopic view will show a complete offset. If this offset is not recognized and corrected a non-union is almost certain to result, regardless of how long the fracture is immobilized. I am convinced that non-union in fractures of the neck of the femur is caused by improper reduction much more often than by the poor blood supply of the neck, so frequently blamed. This improper reduction and consequent non-union can nearly always be avoided if the fracture is immobilized in the extreme abduction, or Whitman position.

Specific instructions from the surgeon as to which particular region of the spine is to be radiographed is most important, together with a suggestion as to the pathology suspected, or else a very brief history of the illness or injury. This is necessary in order to focus directly over the diseased or injured vertebra. I might suggest the following: Cervical, upper dorsal, mid-dorsal, lower dorsal, dorso-lumbar, lumbar, and lumbo-sacral. Stereoscopic views of the spine are invaluable, as they show much more in detail the inter-vertebral spaces and articular processes.

In contrast to the radiologist whose field is largely that of diagnosis, the physiotherapist is concerned entirely with treatment or restoration of function of injured or diseased parts of the body. His field is almost entirely confined to damaged joints, muscles and ligaments. He accomplishes the repair of the damaged parts by the scientific use of massage, manipulation, exercises, gymnastics, moist heat, dry and radiant heat, contrast baths and electric stimulation.

He does the case usually weeks and often months after injury or onset of the disease, and attempts to restore normal or improved function of the part in the shortest time possible. This is necessarily a most important part of the treatment of any case. He should therefore have sufficient knowledge of each case to anticipate the possibilities and limitation that each case presents. Unless he has this knowledge he is likely to do damage where it might be avoided, by applying himself too vigorously, or else not get the desired result by perhaps being too cautious.

This desired knowledge can only be obtained accurately from the surgeon in charge of the case who is familiar with the degree of damage at the time of injury, and the progress of repair up to the time the physiotherapist is called upon for assistance.

The question often arises in the mind of the surgeon as to the proper time to begin physiotherapy. This necessarily must be answered differently for each individual case, but in general, the earliest possible time after injury that physiotherapy can be begun without further injury to the part the better, if the best results are to be obtained.

During the recent World War trained physiotherapists and reconstruction aids were a constant part of every well equipped hospital organization. They were constantly being called upon to massage and exercise muscles and joints of fractured limbs of patients who were still confined to bed in splints or suspended with weight traction. In this way muscles were kept soft and well nourished, and atrophy avoided; and joints were prevented from becoming partially ankylosed and weakened by long periods of disuse necessitated by long periods of immobilization of compound fractures. As soon as these cases became ambulatory they were sent to the physiotherapy department, where moist or radiant heat was applied and more vigorous massage and manipulation and gymnastics prescribed.

The result of this treatment in many cases is almost marvelous. I have seen cases of severe injury to the shoulder joint, in which bony ankylosis has followed, acquire enough sub-scapular mobility to give the patient almost as good function in the injured limb as he had in the uninjured one. Also cases of severe suppurative arthritis of the knee, treated by the mobilization method after operation, acquire complete range of motion; whereas, similar cases treated by long continued immobilization may result in complete destruction of the joint surfaces with resulting bony ankylosis, or what is worse, a few degrees of painful motion.

Delayed physiotherapy not only lessens the degree of restoration of function, but it increases the time required to restore function and subjects the patient to much more pain while this is being accomplished and also delays his return to useful occupation.

I think there are far too many surgeons who rely on their patients to work out their own stiff joints and muscles after a few vague instructions without any supervision whatever, or perhaps a few visits to the doctor's office at irregular intervals where they are greeted with some such remark as, "Oh, it will be all right, just keep on working it." Fortunately, nature is sometimes kind enough to fulfill this prediction, but how often do we see the reverse. The offices of the chiropractors and osteopaths are filled with just such patients, and others that have been improperly diagnosed who have,

for example, injuries of the muscles and ligaments of the back that could be very effectively treated by a well supervised course of physiotherapy.

In conclusion let me urge every surgeon to sense the necessity and value of early physiotherapy; and likewise let me urge the physiotherapists to cooperate with the surgeon by acquiring from him the necessary information regarding the injury to be treated, and by keeping him posted on the progress or limitations of the case.

Equally important is the cooperation between the surgeon and radiologist as I have tried to point out, for without this cooperation accurate diagnosis of the various pathological processes that can be visualized on the x-ray films is often very difficult and perhaps equally often not made at all.

L. N. OSSMAN, A.B., M.D., Salt Lake City  
(Read Before the Utah Society of Radiology and Physiotherapy, September 18, 1923)

### Dr. C. L. Mullins

A MAN of wide experience, both in medical practice and the ordinary affairs of life, Dr. C. L. Mullins, of Broken Bow, Nebraska, the retiring president of the American College of Radiology and Physiotherapy, was able to bring to the College in its formative period an unusual fund of wise judgment and good counsel. Every organization needs this kind of service from some self-sacrificing man in



Dr. C. L. Mullins, Broken Bow, Nebraska, Retiring President of the American College of Radiology and Physiotherapy, Surgeon, Medical Service U. S. Army with service in the Philippine Islands during the Spanish-American War. President of the Nebraska State Medical Association, 1918.



its early days, and the members of the College feel that they have been most fortunate in this respect, because of the vast opportunities for substantial service to the medical profession which open out before an organization of this character which is moved by sound principle, constructive policy, and the absolute will to put away all "petting parties." Mutual admiration societies are perhaps all right in their place, but they have no place in medical science.

Every conscientious medical man knows that the sciences of radiology and physiotherapy are only in their infancy, and that they have proved so useful as to warrant their most assiduous development along sound and carefully thought out lines so as to insure their fair and intelligent application in the practice of medicine by men of reputation and recognized standing.

The difficulty in the past has been that, like all other new scientific developments, these aids to the practice of medicine have been taken up by men wholly unqualified to administer them—men who have not been properly grounded in the fundamentals of medicine. Much has been said about laymen undertaking the practice of these branches of medicine, and assuredly that condition represents an evil which needs to be eradicated with all possible speed. But, mindful of the Scriptural injunction—"Let him that is without sin cast the first stone"—it would seem that those members of the medical profession who are interested and believe in the efficacy of these measures of therapy and diagnosis should band themselves together into a cohesive and practical organization in order that they may elevate their own standards, better their own specialty, and bring proper credit to the medical profession.

Having had the privilege of listening to Dr. Mullins expound his ideas with respect to the College, both in public gatherings and in private conversations, there is no doubt in the writer's mind that these were and are the thoughts which actuated him in the formation of the College. And, believing further, that the men who are now officers in the College realize the full portent of these things and the untold good which now lies within the hands of the members of the College if they have but the will to lay hold of it, it seems

certain that the organization thus founded will go forward rapidly, travel far, and become a worthy monument to the inspiration which begat its conception.

So long as life lasts, Dr. Mullins will be an active participant in the affairs of the College, and a fearless standard-bearer in its slow but nevertheless triumphal march toward the achievement of those things in radiology and physiotherapy which all honest and honorable medical men so much desire.

#### Nobel Prize Awarded to Canadians

THE DISCOVERERS of insulin, Dr. F. G. Banting and J. R. Macleod of the University of Toronto, have been awarded the Nobel prize for their discovery of this great aid to the medical world. An especially pleasing incident connected with this award, an incident by which one's faith in his fellows attains a new root, is Dr. Banting's announcement that he intends to share his part of the prize money with his colleague at the University of Toronto, Dr. C. F. Best, whom Dr. Banting says also deserves to be known as one of the discoverers of insulin.

The well known Nobel prizes were left to the world by Alfred B. Nobel, the Swedish scientist, who first became famous through his discovery of dynamite. When he died, in 1896, he left a fortune, the interest upon which is awarded yearly in five prizes, each amounting to about \$40,000.00. He stipulated that these prizes should be awarded to those whose work in the field of physics, chemistry, medicine, literature, and for the advancement of world peace, should prove to be of preeminent excellence, either as proved by the test of experience or so adjudged by experts.

Six other Americans have received this prize. In 1907 A. A. Michelson of Chicago University won the prize in physics; in 1912 Alexis Carrel, a native of France but now one of our citizens in New York City, won the prize in medicine; in 1914 T. W. Richards of Harvard University won the chemistry prize. Three of our great public men, Theodore Roosevelt, Elihu Root and Woodrow Wilson, won the peace prize in the years 1906, 1912 and 1918, respectively.

## CASE REPORTS

### Infectious Arthritis of Elbow: Differential Diagnosis, Treatment

C. L. Hustead, M. D.  
Falls City, Nebr.

This subject is not presented with the idea of offering anything new in diagnosis but to present a method of treatment, which when applied early to properly diagnosed cases will do much to prevent surgical operations and consequent deformities. However, I feel it is not a mistake to briefly review the diagnosis, especially so when we see patients treated for rheumatism who in fact are suffering from syphilitic, tuberculous or gonococcal infection. The terminology used for the various forms of arthritis has never been definite enough for standard

classification, as the nomenclature differs according to different authors, however, it is my understanding that infectious arthritis is due to bacteria or their toxic products and occurs as a complication of acute infections as well as local diseases of the ear, throat, teeth, abdominal and genitourinary organs. The onset of the general disease is usually sudden and the joint involvement follows in a few days or somewhat later. The condition is usually polyarticular, the original joint clearing up early. There is pain, swelling, limitation of motion,

loss of function and later deformity. It is often accompanied by glandular enlargement with secondary anemia, slight temperature, fast pulse, loss of flesh and sleep. The infection may continue giving rise to distention of the joint with serum or pus which may later require operative procedure and drainage.

Syphilitic arthritis may occur early and even precede the roseola. It is usually localized in the joints which fatigue rather easily, the pain is most marked at night or when the patient lies down and it is relieved by exercise.

## CASE REPORTS

Subacute synovitis occurs which affects a small number of joints, usually one or two at a time. A careful history of the patient, a positive blood or spinal fluid Wassermann and the absence of a local or constitutional disease should be sufficient for diagnosis.

Tuberculous arthritis usually comes on gradually. There may be pain and tenderness with limitation of motion, chiefly of extension and later flexion, supination and pronation. There is swelling of the joint with atrophy of the muscles, and tuberculosis is usually found in other parts of the body.

Gonococcic arthritis is an inflammation of the joint following gonorrheal infection. In many cases the original gonorrheal infection has disappeared and the joint condition has followed a remote or obscure focus, for instance in the pelvis or the seminal vesicles. With a history of previous gonorrhea, in the absence of recent constitutional or known local disease, posterior urethoscopic examination should be made.

The cardinal symptoms of acute rheumatic fever are sudden onset of a polyarthritis flitting from joint to joint, with fever and sweats, the rapid occurrence of anemia and absence of crepitus. The hip and knee joints are most often affected and then, in order of frequency, the elbow, wrist, shoulder, ankle, spinal column and finger joints. Etiology is unknown. The causative association of the bacillus demonstrated by Schueler is not proved though there would seem to be no doubt that a certain number of cases are due to bacterial infection. Prolonged exposure to wet and cold and faulty nutrition aid in a diagnosis.

All joint inflammations should be treated as an infectious arthritis, except in those cases where a specific cause can be ascertained. First of all the source of the infection should be sought and eliminated. The patient should be kept in bed until the temperature is normal with elimination through the bowels, kidneys and skin. Local treatment should be directed with a view of increasing the local

resistance, and this in my opinion can best be done by electrotherapeutics. The technique in using these modalities varies according to the individual operator, and the condition of the joint to be treated. The technique which I have used successfully will be described in the treatment of the following case which I wish to report.

Patient: Female, age 21, clerk in a store.

Personal history: Well up until May 5th except for one abscessed tooth first noted in December and occasional attacks of tonsillitis. Had usual diseases of childhood. No history of gonorrhea or syphilis. May 5th, patient complained of pain in right arm, also some pain in left arm, slight headache and nausea. Went to bed for a few days, when a physician was called who diagnosed rheumatism and prescribed the salicylates. Pain in right arm subsided in a few days but gradually increased in the left arm, and at the end of three weeks patient was no better and was advised to go to Excelsior Springs for baths. At this time the arm was swollen about the elbow to twice its normal size with complete loss of function, considerable pain and enlargement of axillary glands. After several days of baths and following the extraction of the tooth, the patient was informed by her physician that there was a malignancy and amputation was advised. Patient returned home and entered the hospital June 13th. Physical examination showed marked emaciation, loss of weight, left arm greatly swollen from the wrist to the shoulder particularly about the elbow, with large mass of palpable glands in axilla and loss of function of hand, wrist and elbow joint. X-ray examination showed the articular surfaces of the elbow hazy, indistinct and roughened, suggestive of an acute arthritis. The elbow joint was not aspirated but looked very much as though there was fluid in the joint.

Blood examination:

Red cells 4,400,000 with slight poikilocytosis.

White cells 10,000.

Polymorphonuclears 84 per cent.

Lymphocytes 16 per cent.

Wassermann negative.

Urine examination negative.

Temperature 99.5.

Pulse 100.

From the history of the patient, physical examination and x-ray findings a diagnosis of infectious arthritis was made and the following treatment given: Complete rest in bed with light diet, alkaline diuretics and laxatives. The entire body was given a daily actinic raying for three weeks, starting with the mercury quartz lamp 14 inches distance for 20 seconds, increasing 10 seconds daily for five days, then increasing one-half minute a day until the skin became tanned. In conjunction with this general raying the elbow and axillary region was given the deep therapy light and high frequency current with non-vacuum electrode twice daily for 15 minutes to each location for ten days. At this time the swelling of the glands in the axilla was gone and pain was considerably reduced. This treatment was then continued daily to the elbow joint except on every third or fourth day, diathermy was used to elbow with cuff above and below the joint using from 1200 to 1400 ma. for eight minutes at each treatment. At the end of two weeks patient left the hospital, but continued treatment every day for two weeks longer, then every other day for a period of four weeks. During the latter part of the treatment the galvanic current was used with the negative pole to upper dorsal spine and the positive pole to hand and wrist, for the purpose of stimulating the nerves and muscles of the arm. Patient was not able to flex the wrist to the dorsal position at this time. After the acute symptoms had abated tonsillectomy was performed. At the end of ten weeks from beginning treatment her physical condition was normal. The arm had very slight deformity and fully 85 per cent of normal function. At the present time, fifteen weeks from beginning treatments, there is no deformity and patient is working and experiencing no inconvenience or pain in using the arm.

# ABSTRACTS *and* REVIEWS

Roentgen Ray Therapy Twenty Years Ago. William Allen Pusey, M. D., Jour. A.M.A. 81:1257-58, Oct. 13, 1923.

**THE AUTHOR** began the therapeutic use of x-rays in 1900. With the aid of Freund he elaborated a series of therapeutic indications which contained only one indication that proved inaccurate, i. e., the use of the rays to destroy bacteria in living tissue.

The newer technique can be used without long years of training to acquire it and this the author regards as the most important addition that has come into the field of x-ray therapy. Almost as good results were obtained in the old days if patience, care and time enough were given the problem in hand.

The German Roentgen Society. W. E. Schall, B. Sc., J. Roentgen Soc. 19:172-174, October, 1923.

**THIS IS** a brief review of the program presented at the Annual Congress of the German Roentgen Society which met in Munich, April 16th to 18th this year.

The author of this review thus expresses his admiration: "The abiding impression of the whole three days was the enthusiasm and interest which exists for radiological matters in Central Europe. An audience of six or seven hundred which comes and listens with evident interest to lectures lasting six hours a day for three days is a strange sight for an Englishman." No doubt, he says, some of the papers were too long and some should not have been read at all but he adds that one wonders nevertheless why a similar parliament of radiology cannot meet once a year in Great Britain.

Contributions by Voltz and Wintz and others "left the impression that the day of the many-hour single application of x-rays in order to give the carcinoma dose at one sitting is on the wane and that the technique of frequent smaller doses is coming more and more into favor."

Speaking of the commercial exhibits by the Austrian and German firms he is struck by the state of hot cathode tube production, far ahead of that in England, and also struck by the low prices. Open competition he believes explains why these facts are so.

The Value of Bedside X-Ray Studies in the Immediate Postoperative Management of Surgical Cases. James T. Case, M. D., F.A.C.S. Surg. Gynec. Obst. 37:417-418, 1923.

**THE AUTHOR** mentions the value of radiation in the postoperative treatment of malignant and tuberculous disease, and in the management of hyperthyroidism where it sometimes is valuable as an aid to surgery and sometimes is used alone. Fluoroscopic control is of great value in accurately locating radium used in the treatment of esophageal carcinoma, after gastrotomy or before resorting to it and in cancer of the rectum and the rectosigmoid, and in accurate placing of needles.

To ascertain whether obstruction has occurred following gastro-enterostomy or cholecystoduodenostomy, bedside radiological study is useful, for this study 10 to 15 grams of opaque salt is given in plain water.

Postoperative studies following gastro-enterostomy will show how the new opening is functioning and in what position the stomach empties most readily, whereupon the patient can assume and keep the optimum position. Untoward results in intestinal surgery may be explained by roentgen study, especially true when the contents have backed up into the blind end of the colon after iliosigmoidostomy. In the study of a fistulous tract, injection of the same is made with some opaque mixture. The position of drainage tubes or material may be verified and often impending failure turned thereby to success. Especially in ileus following upon abdominal operations is bedside roentgen examination of value in detecting the obstruction. The portable apparatus is used and within 15 to 20 minutes findings are made known. Usually no opaque material is needed for this examination and the patient is no more disturbed than when the bed linen is changed.

The Influence of Heredity on the Occurrence of Cancer. H. Gideon Wells, M. D., Jour. A.M.A. 81: 1017-1021, September 22, 1923 and 1103-1112, September 29, 1923.

**THE MENDELIAN** theory together with the discovery that sarcomas in rats and carcinomas in mice can be inoculated into other animals

of the same species for an indefinite number of generations are the two discoveries that have placed cancer research upon an experimental basis.

In the question of human cancer heredity, all existing statistical evidence is valueless for exact information. Individuals cannot give reliable family histories and clinical diagnosis even in some of the best of the modern hospitals is proved at necropsy to be from 20 to 50 per cent in error. One single error in diagnosis or in history can destroy the value of a mass of data.

About the only thing that can be decided upon from existent data is that a larger number of relatives of cancerous patients have had cancer than have those of non-cancerous patients. However, the existence of "cancer families" cannot be denied and retinal glioma occurring in families is one of the unsolved mysteries. Many interesting instances of familial cancer of various types are cited from the literature. The author adds this parting remark: "As far as I can learn no one has sought out families that show an immunity to cancer."

Animal experimentation is next discussed under the heads of transplanted tumors, spontaneous tumors and mechanism of hereditary influence.

A transplanted tumor differs fundamentally from a spontaneous tumor in that it is a growth of the cells descended from the animal that furnished the original spontaneous tumor and is never a growth of the cells of the inoculated animal. A Jensen carcinoma carried throughout 20 years of transplantation is still a growth from the original cells of the spontaneous tumor from which it was first inoculated. Therefore, resistance to spontaneous tumor bears no relation to resistance to inoculated tumor. Several observations are here made and elaborated upon: (1) The likelihood of successful inoculation becomes more and more remote the more different in origin and character the inoculated mice are from the originator of the tumor. (2) Certain strains of animals are insusceptible to tumor grafts to which other strains of the same species are susceptible. (3) Heredity influences in a constant manner the susceptibility of a given strain of animals to inoculation with cancer. Tyzzer found that a carcinoma arising in a Japanese waltzing mouse could be inoculated into mice of the same type



with a large percentage of success but would not grow in common strains. When the waltzers were bred with the common mice "the mice of the first hybrid generation were all susceptible but the second and third hybrid generations made by cross-breeding the first generation hybrids were insusceptible. The mice of the first hybrid generation although they were susceptible to tumor inoculation, did not show the waltzing character of the susceptible parent strain, whereas the waltzing mice (recessives) that appeared in the second and third hybrid generation were not susceptible to inoculation with the dancing mouse tumor. Further studies carried out with numerous back crosses gave results that indicate that susceptibility to grafted tumors is not inherited as a single mendelizing factor, for they do not furnish a ratio characteristic of a single factor inheritance. Tyzzer and Little believe that both susceptibility and non-susceptibility are inherited as a complex of mendelizing factors, perhaps as many as twelve or fourteen in number."

Loeb and Fischer obtained results not entirely in agreement with those of Tyzzer but they do agree with him and Little that if susceptibility to these tumors is a Mendelian process it must depend on multiple factors.

Of spontaneous animal tumors he says: "(1) Cancer in mice appears in most of the forms seen in man, and in far greater variety than had previously been supposed. (2) The tendency to develop cancer or the capacity to resist cancer is unquestionably influenced by heredity. (3) The resistance to cancer in these mice behaves in breeding, in Slye's experience, like a typical mendelian dominant character. The susceptibility to cancer behaves as a mendelian recessive. (4) Not only the incidence of cancer is influenced by heredity but also its site and its character. (5) Behavior of tumors is influenced by heredity (localization). (6) Inbreeding is not of itself responsible for an increased susceptibility to cancer. \*

\* Inbreeding merely concentrates existing characters but does not produce new characters. \* \* \* In view of all the experimental evidence cited above and the absence of any experimental evidence that contradicts it, the conclusion seems inevitable that the incidence, character, location and behavior of tumors depend to some extent, at least, on the inherited qualities of the animal and of its tissues."

He begins the discussion of the mechanism of hereditary influence by asking how heredity determines susceptibility. Growth stimuli are of various sorts and non-specific. The

same amount of stimulation does not produce an equal reaction in all individuals even though they be of the same species. Not the pathology itself, evidently, but the tendency to develop it is what is transmitted. In Slye's experience the hereditary factors of resistance to cancer may become so high in pure strains of selected mice that no ordinary amount of proliferative stimulus ever overcomes it, for strains of cancer-resisting mice have been developed that have not shown cancer throughout 30 generations of mice, which corresponds to a period of about one thousand years of human life, while on the other hand the capacity to resist cancer may be so bred out of mice that virtually all of a selected strain will develop neoplasms from ordinary proliferative stimuli. In the heterozygous human race maximum stimulation is almost always capable of overcoming resistance but conversely cancer often develops in tissues in which there has been a minimum amount of injury.

Under the topic of the relation of animal experiments to human disease he says: "Certainly these considerations fit well with what we do know of human cancer. Until some one has carried out the arduous studies necessary to confirm or refute Slye's conclusions, as to the exact way in which the demonstrated influence of heredity is transmitted, it may be fair to consider them as at least offering a reasonable explanation of the influence of heredity on human cancer."

In another place he says: "It is known that the principles of inheritance are the same in all species of animals as well as in plants and that cancer, in its fundamental respects is the same in man as in the other mammals; therefore the drawing of conclusions in respect to heredity and human cancer from observations on experimental animals is justifiable." Evidence supports the inference that in man as well as animals the susceptibility to cancer behaves as an inherited recessive character.

**Studies on X-Ray Effects.** Histological Study of the Fate of Cancer Grafts Inoculated into an X-Rayed Area. Waro Nakahara, Ph. D. Rockefeller Institute. J. Exper. Med. 38:309-311, September, 1923.

**MICE WERE** used in the experiments here described. By means of sheet lead in which openings had been cut the animals were rayed completely over the left groin and the rest of the body protected completely. The area was then given a dose of x-rays governed by the following factors: 3 inch spark gap; 10 ma.;

6 inch distance from the target; time of exposure 2 and one-half minutes. Seven days later cancer grafts were inoculated intracutaneously in both the x-rayed area and the area not rayed.

The author thus summarizes the study: "Cancer cells implanted in a skin region previously exposed to an erythema dose of x-rays shows a series of degenerative changes in every way comparable to the frequently described stages of cancer cell degeneration following x-ray treatment. These findings contrast strongly with the survival and growth of grafts implanted in unexposed regions in the same animal. Since the changes are the same whether the cells have been directly exposed in situ or merely implanted in the previously exposed skin, it follows that it is impossible to establish microscopically a direct injury from the x-raying as the principal factor in the therapeutic action of x-rays on cancer."

**The Value of the X-Ray Report as a Liaison between the Roentgenologist and the Referring Physician.** Edward S. Blaine, M. D. Illinois M. J., 44:185-191, September, 1923.

**THE VALUE** of any x-ray report depends upon how well it transfers to the referring physician the information contained on the films. Very detailed findings are outlined for reports on the thorax, alimentary tract, urinary tract, sinuses, mastoids and skull and the author says that when such thorough analysis is generally adopted by roentgenologists that the value of the x-ray as an aid in diagnosis will rise to the place it should occupy in the medical field. Detailed reports do away with the necessity of the referring physician seeing the films, the fact that he now needs to see them is a reflection on the interpretation of many roentgenologists. A duplicate film should always be filed in any case. There is a great lack of uniformity in x-ray reports, too many are meaningless or inadequate and a more satisfactory manner of reporting findings should become standard.

In general a good x-ray report regardless of the lesion should contain the following:

1. Exact anatomical region included in the examination giving the limits in terms of the anatomy.
2. The projection directions, anterior-posterior etc.; posture of patient; number of exposures and films used and the size of films.
3. Whether the shadows of the bones correspond with the age, weight, height and sex of a normal individual of like age; main shadow features bearing directly upon the suspected lesion; secondary or additional changes.

4. Specific statement as to normal portions included in the examination.

The report should be specific and take nothing for granted or as unimportant.

Deep Roentgen Therapy and Skin Reactions. P. Del Buono, M. D., Naples, Italy. *Am. J. Roentgenol.* 10:745-753, September, 1923.

**T**HE AUTHOR remarks that the terms *radiosensitivity* and *selective action* of a cell or group of cells with respect to x-rays have as yet no definite meaning.

The general consensus of opinion is that there is no such thing as a true idiosyncrasy for x-rays. The pathological phenomenon of idiosyncrasy is that a minimal dose of the drug or element produces shock but feeble doses of x-rays do not react violently, i. e., in burns, necrosis, etc. Either too short target distance or too large a proportion of soft rays may produce a skin lesion following x-ray diagnosis. Distance should be 40 cm. and a filter of aluminum or leather used.

However, it cannot be denied that there does exist a hypersensitivity and a hyposensitivity for x-rays on the part of some individuals. Age, complexion and area have something to do with this. Predisposition or an abnormal state of the skin on account of disturbances due to nutrition, growth or change, no matter how caused, may render a dose intolerable for one individual which for others would be a therapeutic dose.

The vascular system suffers most from irradiation and when the vessels have lost their power of defense changes in the tissues may proceed even to necrosis. The endothelial cells of the blood vessels are selectively radiosensitive. In larger doses the epithelium, the fixed connective tissue cells and the lymphatics are injured. The vascular endothelium is the last to recover. The capillaries of the corium are affected by very small doses, loss of elasticity first appears and the vasomotor system ceases to function well and the skin's power of resistance is handicapped. Larger doses may eliminate the lumen of the vessels.

Skin necrosis does not occur easily when the blood vessels are injured by the rays, for the reason that the vessels are not all injured to the same extent and that those which are more distant are uninjured and contribute to the supply needed by the tissues. But when there exists a weakness in the vessels small doses of rays may cause serious injuries. In nephritis the change which in a normal individual would not manifest itself for six days will appear in three days. This

is also true in vagatonics and in Basedow's disease.

The thickened skin which always occurs after radiation is of no serious consequence providing that area is not again irradiated.

The boundary line between an intense erythema which heals easily and may be considered physiological and one which is pathological may be reached either by an excessive dose which works injury and shows effects after a very short latent period or by the cumulative action of the rays.

The different degrees of erythema as adopted by the different groups are described. Seitz and Wintz call that an erythema dose which produces soon after irradiation a slight redness which after three weeks will appear darker and in six weeks is bronzed. Less than 35 units of their electrometric system will not produce this change, more than 35 units will produce a severe reaction with a possibility of first degree burn. Friedrich and Kroenig with their unit dose secure an erythema much more marked than do Seitz and Wintz. Their erythema dose is identical with the so-called inflammation dose of Opitz. This produces an inflammation of the first degree accompanied by a temporary reddening; 170 to 180 "e" of their electrometric units give rise to the above reaction while 210 "e" produces a second degree erythema with excoriation of the skin and in many instances vesication. Warnekros finds a difference of 30 to 40 per cent in different patients in the amount of radiation necessary to produce the reddening and later tanning of the Seitz and Wintz dose. The maximum skin dose as he uses it is one that produces a pronounced dark red color of the abdominal skin, with papular separation of the epidermis and a profuse secretion from the raw surface. This dose is greater than the carcinoma dose in the ratio of 100 to 85 but Warnekros records no serious injury from its use. But the author of this paper says there always remains the question of whether the dosage can be exactly duplicated.

He says that the skin submitted to the penetrating doses used these days "not only should not be radiated again but should be protected from external injury (trauma) which may impede nutrition and delay or stop the process of recovery. There should then be no danger of late burns, since the steady improvement in the circulation and the recovery of the vital functions of the elements of the tissue cannot possibly account for the formation of late ulcer and necrosis. But this is not true if, at the time of recovery of its normal functions, the

tissue be radiated again. The injury may not show itself immediately; years may pass, but finally, neither the defensive strength of the organism in general, nor the assistance rendered by the neighboring tissue, can save the tissue and prevent slow necrosis."

Rost, Kroenig and Friedrich from their studies have concluded that injuries are of similar character whether produced by radiations of long or short wave-length.

Finally the author says that "variations in the primary voltage may cause such changes in the tube voltage as to give considerable increase of dose, sufficient to account for all types of injury. Poor coal and defects in the electrical distributing system cause line fluctuations between afternoon and evening from 170 to 250 volts. This is sufficient to cause a good deal of trouble unless proper precautions are taken.

Roentgen Rays in Lymphogranulomatosis (Hodgkins Disease). Dr. S. H. Chaoul and Kurt Lange, *Strahlentherapie* 15:620-623, No. 5, 1923.

**T**HE PATHOLOGICAL condition while so well described by Hodgkins, 80 years ago, is so far only known as a chronic inflammatory, infectious process of the lymphatic system, which, in a large number of cases, appears to be associated with tuberculosis. The causative agent is unknown. Roentgen ray therapy in this disease has met both successes and difficulties. The first enthusiastic reports by Senn who saw large tumor masses completely disappear under the influence of the rays were soon followed by disappointments when recurrences were found to arise from hidden granulomatous nests.

Better therapy succeeded in prolonging life from one to two years. Cases of patients who lived from 7 to 11 years after roentgen ray therapy were reported by Karl Meyer and Schwartz.

The difficulty in treatment, aside from recurrence, consists of the fact that the organism is heavily taxed to dispose of the albuminous material resulting from the sudden decomposition of these large masses. In cachectic individuals such sudden reaction assumes a menacing aspect.

Chaoul, therefore, gives a series of small radiations with short skin focus distance. One of the patients received a series of 37 treatments, and has been free from recurrence for two years. The technique used by Chaoul is as follows: 1 mm. copper filter, at each treatment 10 per cent of an erythema dose is given until 60 to 70 per cent is delivered within about

six weeks. At first treatments are given daily, then every second day, then every third day, finally one every week. Always a large field with the large gatherer (an instrument to re-assemble scattered radiation?) is employed. In the generalized form the whole body may be treated. After three months a repetition of the course is given.

The authors agree with Holzknacht and Petersen that the complete disappearance of these tumors is characteristic of lymphogranulomatosis.

The authors treated 12 cases and with the exception of one where the mediastinum was involved they were all cured to the extent that they returned to work.

The following end-results are given: With the exception of two cases who died of some other disease, one with mediastinal Hodgkins died after eight months, and another after two years, and of the eight cases remaining there was only light recurrence in one, while in the others there is an average of two and one-half years without recurrence.

Regarding the blood picture the authors observed a marked rise in eosinophiles, at times up to 17 per cent, during irradiation, while previously, no pronounced eosinophilia was found. The authors consider the appearance of eosinophilia a good prognostic sign. No other changes were found except an absolute drop in leukocytes.

A. M. PFEFFER, M. D.

Differentiation by Swallowing Between Intra or Extra Pulmonary Site of an Opacity with Shadow Outline of the Apex. Dr. Josef Eordelyi, Klin. Wchnschr. 2: No. 33, August 13, 1923.

**C**IRCUMSCRIBED shadows in the apical region are of great diagnostic importance. It is, however, necessary to determine that such calcified shadows are of intrapulmonary and not of extrapulmonary origin. Such shadows often result from calcified glands within the soft parts of the supraclavicular fossa, or calcified spots in the enlarged thyroid.

The usual means of differentiation are: (1) coughing, allowing the patient to cough will at times move the spot outside of the pulmonary outline; (2) examination in various views which will often show a more clear-cut outline in one view than in another, thus showing its proximity to one surface or another.

The author found that the above means were insufficient in some cases, and he suggests that these cases be examined fluoroscopically, and the patient be asked to swallow. In swal-

lowing most of the muscles of the neck and of the supraclavicular fossa are moved by the movements of the tongue and hyoid bone, while the lungs are in their usual position. An opaque spot moving with swallowing is therefore definitely outside of the lung tissue.

The author urges the use of fluoroscopy along with the roentgenogram in all cases where differentiation is necessary.

A. M. PFEFFER, M. D.

Examination of the Posterior Mediastinal Glands in the Early Recognition of Pulmonary Tuberculosis. Lloyd B. Crow, M. D., Am. J. Roentgenol. 10:699-701, September, 1923.

**T**HE LYMPHATIC vessels of the lungs consist of two sets, the superficial (placed beneath the pleura and covering the outer surface of the lung) and the deep ones which accompany the blood vessels and run along the bronchi, terminating at the root of the lung or hilus region. These glands are intimately connected with those of the posterior mediastinum. The lymphatic vessels of the esophagus form a plexus around that tube, traverse the glands in the posterior mediastinum, and after communicating with the pulmonary glands and the vessels at the root of the lung, terminate in the thoracic duct. The posterior mediastinal glands are situated in the areolar tissue of the posterior mediastinum, forming a continuous chain by the side of the aorta and the esophagus, communicating on each side with the intercostals below and with the lumbar glands and the deep cervical above." There is, therefore, a possibility of infection from the nasopharynx and the buccal cavity directly to the hilus of the lung.

The patient stands at an angle of 45 degrees with the left scapula against the fluoroscope and the right shoulder touching the screen. This position must be varied so that the maximum amount of space between the heart and the vertebral column be obtained in the visualization of the postcardiac space. This is first done with the open diaphragm and if considerable infiltration has taken place the whole field will be darkened; if infiltration is fairly heavy then a chain of glands will be seen distinctly, extending from the upper portion of the hilus space to the hilus region, and in some cases to the inferior portion of the space; if infiltration is slight then thin narrow lines are seen extending downward like lines of rope. The glands in the upper and lower portions may not be visualized and many normal cases may show infiltration of the

glands in the postcardiac space, in these cases there is usually a history of previous lung involvement. Recovered cases will show involvement of the posterior mediastinal glands but instead of general involvement they will appear as rounded shadows forming a chain with the appearance of scattered shot. The picture in advanced cases varies.

In conclusion the author states that his study of 4,000 cases has led him to believe that as a negative sign, the non-involvement of the glands in the posterior mediastinum possesses great value in eliminating pulmonary tuberculosis in suspected cases.

Two Cases of Localized Metastatic Carcinoma of the Vertebrae without Demonstrable Primary Lesion. Cyril P. O'Boyle, M. D., Am. J. Roentgenol. 10:711-714, Sept., 1923.

**T**WO CASES of metastatic carcinoma of the vertebral column are reported in which the primary focus was not demonstrated. Pain was the most prominent symptom and was manifest upon movement. Roentgen examination should be made in all suspected cases as they are usually readily diagnosed by such means.

Typical Disease of the Second Metatarsal-Phalangeal Joint. Dr. Alban Kohler, Wiesbaden. Am. J. Roentgenol. 10:705-710, Sept., 1923.

**A**T THE site complained of the roentgenogram sometimes shows a joint-space of double breadth where the second or third metatarsals or both, articulate with the toes. There is a definite proximal displacement of the metatarsal involved. The disease is not especially a rare one, at least within the last two and one-half years the author has found many cases. The etiology is obscure. He believes that trauma plays a part but he also believes that a certain debility of the osseous system is probably largely a factor. This he believes is less infectious in nature than it is toxic, the general resistance of the organism is lowered and the effect becomes manifest at the point of greatest strain. As treatment he advises rest, noulities, baths, heat, massage, good food, air and sunlight and the use of a well fitted shoe with an inlay designed from a plaster cast.

Discussing the bony changes the author says: "The disease involves the articular surface of the base of the proximal phalanx of the second toe (seldom the third or both together) the metatarsophalangeal joint, the articular surface of the head of the metatarsal, the head itself, and the whole distal half of the metatarsal. These structures are altered in the



following manner: "(1) Shadow of articular surface of proximal phalanx in plantar-dorsal exposure loses its perfectly circular form, becomes irregular, often an S-shape. (2) Joint-space is usually broader than normal. (3) Broadening is strikingly irregular, the fibular half of the space being often double the tibial half. (4) Articular surface of head of metatarsus loses its normal roundness, is only more or less flat in early cases but in old ones it shows quite irregular knobs and defects. (5) In advanced cases there are from one to several shadows on the fibular aspect of the joint and even deep in the soft parts. These shadows vary in size from that of a pin head to that of a lentil and resemble the calcified plaques in the capsules of the large joints, but are always circular. (6) Head of the metatarsal is undoubtedly shortened in its distal third, as though the cap had been driven in. (7) In all frank cases the whole distal half of the metatarsal is more or less altered and is definitely increased in circumference so there is no longer a constriction at the site of the neck so that the distal half is often like the proximal in size and shape. The thickening is not confined to the medulla but involves the cortex, which however, thins out normally toward the proximal end of the bone. In contradistinction to osteomyelitis and spina ventosa is the increase in the size of the bone distally, and also the spongiosa as far as the tip of the bone appears regular and of well-ordered design.

Report of Results of X-Ray Treatment in Pyorrhea Alveolaris. G. Von Poswik, M. D. Am. J. Roentgenol. 10:724-725, Sept., 1923.

**THE AUTHOR** submits three case reports of pronounced cases of pyorrhea which he treated by x-ray radiation and which are seemingly cured as a result.

The author's plan is to take the patient's history and pay particular attention to oral conditions. Next a bacteriological examination is made, then an x-ray examination. Then the teeth are scaled and the dentist instructed not to use iodine or anything else that would contra-indicate x-ray treatment. No toothbrush is used. X-ray treatments are then instituted (p.r.n.) and bacteriological examination is made before each treatment. A weekly inspection is made.

With the first patient the author used the following technique: 6 ma.; 6 min.; 6½ inches; 8 inch spark gap and a filter of 2 mm. Al, 1 inch wood, 2 mm. Al, and sole leather. With the last two he used 5 ma.; 4 min.; 6½ inches distance, 8 inch spark gap and filter of 2 mm. Al, 1 inch wood, and

sole leather. Does not say why technique was changed. Results were good in all three cases.

A Visit to Some South American Radiologists. James T. Case, M. D., F. A. C. S., D. M. R. & E. (Camb.) Am. J. Roentgenol. 10:754-763, September, 1923.

**THIS IS** a very interesting account of the author's visit to the leading radiologists in some of the larger cities of South America. He mentions among other interesting things that at the new Institute of Surgery of the University of Buenos Aires he found for the first time in his experience a public teaching hospital with ideal roentgenological equipment. The culture and scientific attainments of these South American workers commanded the admiration of each American visitor. The private institutes of Carelli and of Heuser are said to be models from the standpoint of both equipment and art.

Dr. Heuser gave a demonstration of cases treated with deep therapy. Heuser believes in preoperative roentgen radiation of cancerous patients. In treating uterine fibroids he has succeeded in reducing the volume by 80 per cent and he recommends the removal of the remaining nucleus as it is difficult to forecast developments.

The Treatment of Uterine Fibroids with Roentgen Rays. With Illustrations of Original Appliances. James N. McCoy, M. D. Am. J. Surg. 37:238-240, September, 1923.

**CONCLUSIONS** by the author: "X-rays constitute the best possible remedy for uterine tumors except calcareous tumors and chondromata. Hysterectomy is wholly unwarranted in the great majority of cases of uterine tumors. Hysterectomy is a grave operation with an appreciable death rate, while x-ray is without danger to the patient. Care of uterine tumors can be effected without producing the menopause or a dysfunction of the ovary."

Ventriculography: Its Place in Brain Surgery. George L. Davenport, M. D. Illinois M. J. 44:179-181, September, 1923.

**THE AUTHOR** has made use of this procedure in 28 cases of intracranial lesions. Operative treatment was instituted in 11 of these cases and nine patients died within from a few hours to seven months after the operation. Operative results should not be judged simply by the remote results and the mortality, for temporary results save these patients untold suffering and blindness.

Brain surgery, he feels, is bound to improve with the careful use of this procedure.

Fifteen Years' Experience with the Fractional Dose Method of Treating Cutaneous Malignancies. J. M. Martin, M. D., Am. J. Roentgenol. 10:726-733, September, 1923.

**SINCE** 1918 the author has used a Coolidge tube with interrupterless transformer, and has employed a more radical technique in treating these malignancies.

For a single exposure he uses a 10 inch target skin distance, 5 inch spark gap, 5 ma., ½ mm. Al placed just beneath the tube, time five minutes. Exposure is made every other day and the number of exposures ranges from two to ten. "According to the formula of Witherbee and Remer for filtered dosage, an erythema dose was administered at each sitting. The smaller lesions received from two to four exposures while growths of moderate size received six exposures. Only occasionally was it found necessary to use as many as ten exposures. The only factor that was varied with this technique was the number of exposures. The rays were in each case sharply limited by means of cones and shields to the lesion and a narrow strip of skin surrounding it. When practical, the skin covering the lymphatic channels draining the area occupied by the lesion was subjected to an erythema dose administered through heavier filters. Fifty ma. min. were given through 4 mm. Al and four thicknesses of sole leather with an 8 in. parallel spark gap and a target skin distance of 10 in. I have not seen fit to alter this technique and am using it at the present time." Most of the author's patients come from a distance and cannot stay longer than two weeks nor are they willing to return at monthly intervals which the single exposure intensive method makes necessary.

The single exposure has not yielded satisfactory results in the author's hands but he has found the majority of cases treated by the multiple dose method do not require a second series of treatments. In all but the small lesions a second degree reaction is produced no matter how large the lesion or where situated. He believes that treatment must be radical and that the neoplasm must be eradicated at the first series of treatments if at all. He has not found that atrophy, telangiectasis and keratosis are disturbing factors and the changes which do occur are so insignificant compared to the original lesion or to the changes produced by surgery that they can be disregarded.

Most of the author's patients come from a distance and cannot stay longer than two weeks nor are they willing to make return trips at monthly intervals which the single exposure intensive method requires. He routinely has a photograph taken of each patient who begins treatment and other photographs are taken during the course of treatments if anything interesting comes up. When the patient is discharged and sent home he is given ten postcards addressed to the author, with the date upon which they are to be mailed written in red ink. He is to return one of these with the blanks filled out every six months and if he fails to do so he receives a written inquiry. The author has used this follow-up system for four years and expects eventually to have data worth consideration.

In conclusion he says: "From long experience we are of the opinion that repeated erythema doses of x-rays in the treatment of malignant conditions of the skin are productive of better results and more lasting effects than single dose methods. Our conclusions are based upon an experience of more than fifteen years during which we have treated more than 2,000 cases."

The Roentgen Ray Versus Vaccines in the Treatment of Acne. Howard Fox, M. D., Jour. A. M. A. 81: 1417-1421, Oct. 27, 1923.

**A**LTHOUGH not a serious disease as affects health acne affects the peace of mind of the individual and sometimes his earning capacity.

In the hands of a careful operator using modern apparatus and measured dosage the roentgen ray is safe and efficient and the results secured thereby are more permanent than by any other means.

Whatever value vaccines possess is restricted to their use in selected cases, chiefly of the pustular type or as an adjuvant to other forms of treatment. Their action is slow and often improvement is only temporary. The roentgen rays are far superior as a form of treatment.

Roentgen Diagnosis of So-Called Chronic Appendicitis. Dr. F. Ehrlich, Deutsch. med. Wchnschr. 48: 449, April 6, 1923.

**I**T IS the author's experience that in all normal cases six hours after ingestion of the barium meal the small intestine is empty and that the cecum, complete ascending colon and part or complete transverse colon are filled. Gross deviation is pathological and caused by pathological reflexes which either retard or increase the peristaltic movement.

Chronic appendicitis is one of those pathological conditions which retards

peristalsis. It may cause the retardation mechanically, as by adhesion formation, or in a purely reflex manner.

If after six hours a few of the last coils of the small intestine are still considerably filled, or if the meal has not yet passed into the ascending colon, in absence of gastric residue, of stenosis of the small and large intestines, and peritoneal disease, the author unhesitatingly diagnoses the condition as chronic appendicitis.

In 17 cases with only this one finding disease of the appendix or of some neighboring structure was found at operation. In one case a tuberculous condition of the ileocecal region was found.

The author finds this roentgenological observation pathognostic of chronic appendicitis even though there are no other grounds for such diagnosis but it is of no importance in differential diagnosis and the nature of the disease process cannot be inferred from this finding.

A. M. PFEFFER, M. D.

Physiotherapy. W. W. Carey, M. D. J. Indiana M. A. 335-338, October, 1923.

**T**HE DEGREE of success met with in the practice of physiotherapy depends upon the knowledge of the modality used and the method of its application. Only study and experience can make the successful practitioner.

Neurotic patients are tremendously aided by physiotherapy. In neuropsychiatry the mere fact of treatment acts as a tonic and gives the patient courage to bear up until nature gets a chance to do her work.

Fractures and dislocations are aided by the absorption of inflammatory products and the prevention of atrophy. Hastening of bony union and promotion of metabolic processes is brought about by physiotherapy and there is a more speedy restoration of function. Heliotherapy, diathermy, iodides, rest and proper food are advised. Many cases of adhesions yield readily to treatment.

In some cases of osteomyelitis, copperization and ultraviolet rays with massage accomplish wonders. Tuberculosis of the bones will respond to ultraviolet treatment when all other means have failed. Ultraviolet in rickets need only be mentioned.

The different types of paralysis are more or less aided by physiotherapy. Only the most skilled operator can accomplish results here. Cerebral paralysis is the most difficult form to treat but even it is sometimes helped by rest, massage and electrical stimulation. In spinal paralysis surgery is first called upon and physiotherapy used as an aid. Hemorrhage of the cord calls

for the same treatment. Peripheral nerve paralysis can be aided to a greater degree than can any other form. In infantile paralysis the condition for regeneration is more favorable than in traumatic peripheral paralysis. Stretched muscles that have not functioned for many years but are not paralyzed may be restored by electrical stimulation.

Ulcers are much benefited by physiotherapy. In neuritis the cause must be removed by whatever means is necessary and physiotherapy then used. Sciatica, lumbago and all forms of myalgia yield readily to diathermy. Torticollis responds less readily. The progress of arthritis can sometimes be arrested though it cannot be cured. In neuro-cardio asthenia at least 60 per cent of patients are cured.

Dementia praecox is incurable but mental trouble of the praecox type clears up. Epilepsy *grand mal* cannot be cured but *petit mal* can be.

Biological Reactions of X-Rays: Effect of Radiation on the Nitrogen and Salt Metabolism. Carl F. Cori, M. D., and G. W. Pucher, Buffalo General Hospital. Am. J. Roentgenol. 10:739-745, September, 1923.

**T**HE DATA cover the field of both moderate and heavy x-ray therapy and confirm that of previous investigators as regards nitrogen metabolism. In all cases the total nitrogen was increased in the postradiation periods. Of the nitrogen fractions determined, the urea plus ammonia and the uric acid were the only ones which showed any increase.

"In the first two cases \* \* \* which had tumors that could be readily observed, the increase in the total nitrogen was parallel to the decrease in the size of the tumor. Since we also observed an increased excretion of phosphorus, it is very probable that a great part of this increase of total nitrogen was due to the elimination of destroyed cells. In this connection the increased output of urea and ammonia and of the undetermined nitrogen gives a partial insight into the mechanism involved in the decomposition of those cells destroyed by the radiation.

"In Case I the weight of the tumor mass before radiation was estimated at between 200 and 300 gm. It will be seen that there was an increase after the radiation of about 3.6 gm. of nitrogen, corresponding to 22.5 gm. of dry protein. Estimating that the average tumor tissue contains about 10 per cent protein and 80 per cent water it will be seen that 225 gm. of tumor tissue were actually destroyed.

"These experiments also indicate that 'roentgen sickness' is not due to

excessive cell catabolism, since Cases I and II having the largest tumors and greatest increased nitrogen excretion were scarcely inconvenienced by the x-ray treatments, while Case III with the smallest tumor and lowest nitrogen output, suffered a very intense post-radiation reaction.

"The influence of radiation of the inorganic metabolism was most unexpected, in that in all cases a marked retention of chlorides was observed, a retention far greater than could be accounted for by a possible retention of fluids. This is clearly demonstrated in Cases I and II where no decrease in urine volume or gain in weight could be observed. In fact the retention of chlorides was so pronounced in Case II that not even forty-eight hours after a high salt diet was there a very marked increase in the chloride output. In Case III although the urine volume decreased one half, yet the chloride excretion was eight times below its normal value without any gain in weight. How long this chloride retention would have lasted could not be determined in these cases, but animal experiments are in progress which we hope will clear up the mechanism and factors involved in this phenomenon."

Ovarian Tumors Following Roentgen Castration. E. Vogt, M. D. *Strahlentherapie* 25:470-472, Nov. 4, 1923.

IT IS generally assumed that roentgen ray castration destroys the graafian follicles of the ovary, and that any unharmed follicle may mature later on and yield ova capable of reproduction.

The author calls attention to another feature observed to follow roentgen castration, namely, the rise of cystoma and of ovarian carcinoma in cases where before radiation the adnexa were free from such lesions.

He cites two cases of roentgen castration done for myoma whereupon large cyst formation followed. Microscopically the cysts were found to be pseudomucinous. Two other cases were treated for menorrhagia and developed carcinomata. One case of cylinder-cell sarcoma of the gall bladder developed metastases in the adnexa and cervix following irradiation.

The cyst formation and the development of carcinomata which histopathologically arise from epithelial or germinal structures prove that after irradiation the epithelial cells did not lose the capacity to give rise to malignant tumors. Also the connective tissue may have been affected to some extent as evident from the case in which a cylindrical cell sarcoma was allowed to form.

The author is of the opinion that not only does irradiation not destroy the

cellular structures completely, but that the internal secretion of the ovary is not fully done away with. As corroboratory evidence he calls attention to the following facts:

(1) Certain attempts to reduce hypersexuality by irradiation failed, while removal of the ovaries was effective. (2) Fehling's case of osteomalacia did not respond to irradiation of the ovaries, but complete cure was effected through their surgical removal. (3) Young women suffering from pulmonary tuberculosis who were castrated by x-rays, now have a persisting amenorrhea, and show certain unfailing signs of the setting in of the climacteric.

The author concludes that irradiation of the ovary, although followed by amenorrhea, cannot be considered as completely removing it whether considered morphologically or as internal secretory gland.

A. M. PFEFFER, M. D.

The Goitre Problem. W. A. Rush, M. D. *Nebraska State M. J.* 8: 354-358, October, 1923.

THE AUTHOR insists on the importance of the patient being under the care of a competent internist for supplementary treatment during the period of x-ray treatment.

X-ray treatment is highly efficient and safe in competent hands, it is more economical than operation and it has no mortality.

X-ray equipment has been perfected to a remarkable degree of efficiency and it is possible to estimate dosages with accuracy. Over-irradiation will not occur if treatment is checked by basal metabolism readings.

Observations on the Lateral Position and Other Methods of Examination of the Renal and Gall-Bladder Areas. Sir John Thompson-Walker, M. B., F. R. C. S., and Robert Knox, M. D., M. I. E. E. *Am. J. Roentgenol.* 10:681-696, Sept., 1923.

THE OBJECTIONS to the lateral position in examination of these areas is that kidney sinks forward and toward the middle line and if its mobility is increased the changes in its relation to the vertebral bodies (the fixed points of a lateral radiogram) are considerable. Also in this position perirenal adhesions will interfere with what might be regarded as a normal variation in the position of the kidney and the renal pelvis may be emptied by the muscular effort of changing position.

Part of the value of a lateral radiogram depends upon comparison with the anteroposterior view and both these views should be taken with the patient in the same position, so it is essential

that the lateral negatives should be taken with the patient lying either prone or supine, and the lateral is more preferable for an ordinary kidney negative.

When pyelography is used, a rapid combined method should be worked out and practiced by the surgeon and the radiologist. The essentials are rapidity of action, shortness of exposure and a tube of the proper degree of hardness for the particular conditions. Description is given of a table by which means it is possible to screen from below and take negatives from above and from the lateral aspect in a short time without in any disturbing the patient. A duplitzed film with two intensifying screens is used, one on either side of the film.

Lateral radiography may be used alone or with an opaque catheter (best ones of Paris make) or in combination with pyelography. The catheter with a terminal eye must be withdrawn one-half centimeter after it has passed the full length and been arrested, for if this is not done there will be imperfect filling of the pelvis and remaining calices and because the patient will feel pain when the upper calyx is distended the operator will be misled into believing that the pelvis is already full. If desired to study the contour of the uretero-pelvic junction, the catheter must then be withdrawn about two centimeters.

The authors have used sodium bromide, 20 per cent solution. It throws a less dense shadow than collargol. The solution must not be stronger than 20 per cent, and must be sterilized by boiling, and oxycyanide of mercury added (1:8,000) to keep it aseptic. Full directions for injection are given.

Interpretation: Accurate anatomical knowledge is absolutely necessary here. The anatomical points upon which localization in an anteroposterior view depends, are the last two ribs, especially the twelfth one, the bodies and transverse processes of the lumbar vertebrae, the crest of the ilium and the oblique outer margin of the psoas muscle. In the lateral position the ribs give no help except to mark the twelfth dorsal vertebra, the bodies and spines of the lumbar vertebrae are the structures by which one is guided here.

The shadow of a normal radiogram can be recognized in a radiogram of the first quality and the particular points in recognition of a normal shadow are given in detail.

Gall-bladder pathology often results in a thickening of the gall-bladder walls which will show in a radiograph properly taken. Gall-bladder position varies greatly in different individuals. "It may occupy the space between the twelfth rib and the outer border of the



## ABSTRACTS AND REVIEWS

psoas muscle usually occupied by the kidney. The shadow is elongated, pear-shaped, with the apex above. It lies nearer to the twelfth rib than does the kidney shadow and its long axis is not parallel to the outer border of the psoas muscle shadow, as in that of the kidney but bisects the angle between the twelfth rib and the psoas. \* \* \* Very considerable variations are found in the relation of the gall-bladder to the bony landmarks, and this is not always due to the varying positions of the gall-bladder, for the twelfth rib may be long and very oblique, so that the costo-vertebral angle is narrow. The gall-bladder shadow is then in relation to the twelfth rib and last costal space. The long axis may be more vertical or more transverse. In the lateral view the gall-bladder lies anterior to the lumbar vertebrae and reaches as low as the third lumbar vertebra."

There are variations, of course, brought about by disease conditions and these are discussed at length. The divisions of the remainder of the article are: Psoas Abscess; Shadows in the Kidney and Gall-Bladder; Position of a Shadow in the Kidney Gall-Bladder Area; Size and Shape (of renal and biliary calculi); Density and Uniformity of Shadows; Grouping of Shadows and the Effect of Respiration; Pyelography; Lateral Radiography and Pyelography.

Temporary Suppression of Urine Following Double Pyelography. Henry H. Morton, M. D., *Jour. Urology* 10:261-265, September, 1923.

**THIS IS** a case report made for the purpose of calling attention to the danger which is attendant upon doing a pyelography of both kidneys at the same time.

Bromide of soda solution, 25 per cent, was used in the case here reported and there had before this time been no untoward results from a double pyelography in the author's hands.

The patient's history pointed to a calculus in the left kidney or ureter. Urine was cloudy, acid, with a large amount of pus and a moderate number of red blood cells. Cystoscopy showed the bladder to be normal. No shadow showed in either kidney but a shadow of a small calculus was clearly visible in the lower ureter one and one-half inches from the bladder. The pelvis of each kidney was then filled with the solution by gravity method and pyelograms were made. The patient did not complain of pain at the time but on returning to the ward he did so complain. The pain was in both kidneys, lasted throughout the night and complete suppression of urine followed for two days.

Radium Needles in Malignant Growths of the Tongue: The Time Factor. A. James Larkin, M. D., *Am. J. Roentgenol.* 10:734-735, September, 1923.

**CONCLUSIONS:** "Standard needles containing 12.5 mg. radium element placed 1 cm. apart and parallel in malignant growths of the tongue yield the best clinical results if left in place eight to ten hours.

"Six-hour application permits of recurrence in situ.

"Twelve and eighteen hour applications produce excessive sloughing with tendency to hemorrhage and such severe reactions that the patient's local and general resistance are seriously lowered."

Roentgen Diagnosis of Duodenal Ulcer. Direct Roentgen Symptoms. Ake Akerlund, Mitt. a. d. Grenzgeb. d. Med. u. Chir. 36:577-589, No. 5, 1923.

**THE AUTHOR** lays special emphasis on technique, pointing out the numerous difficulties in obtaining a clear projection of the bulb. It is absolutely essential to obtain the best possible views of the cap in various positions and so project them on the plates. Yet it should not be too time consuming. It should last about fifteen minutes for simpler cases, and about thirty minutes for more complicated ones.

Manual expression of stomach contents, blockage of the pars inferior duodeni, and certain positions will often bring about visualization of the cap. The author takes a series of 12 roentgenograms on 3 plates using a cassette, one-fourth of which is open and the other three-fourths protected with lead. The position of the duodenum is previously determined by fluoroscopy.

Does a duodenal ulcer always produce roentgenologically demonstrable changes? The author is certain that every open ulceration which affects the deeper coats of the duodenal wall, produces changes in form or contour.

The following changes in contour are observed: (1) Projection of the opaque substance into the crater of the ulcer producing a niche. (2) Defect in bulb shadow produced by either scar tissue formation, adhesions or spasm. (3) Flattening or shrinking of the cap produced by shrinkage, spasm, or infiltration. (4) Pocket formation or projection in the form of a diverticulum.

The author does not agree with the accepted idea that niche formation in the duodenum is too rare to be considered of practical importance. He finds it just as frequently as in stomach

conditions. He found it in 60 per cent of definite duodenal ulcer cases.

The size of the niche is variable. One he found as large as a half of a walnut, the other was barely the size of a pin head.

The site of predilection for the niche is the medial wall of the bulb. Rarely they are found in the lateral and pyloric borders. Along with the niche, there is very often accompanying retraction and defect formation. It altogether gives the impression of a miniature of the stomach ulcer.

While defects are thought to be due to organic changes, yet a large part of it is purely functional, being due to spasm. The defect may be found in the pyloric, lateral and medial borders. It is more prominent and is usually found on the lateral border. The defect on the pyloric border is pea sized and over the lumen. It is usually produced by a small fissure in the muscularis mucosa. The spastic condition of the cap was found in some cases to increase in the later stages of digestion, which may account for the hunger pains in those cases. Paradoxical retention, (hypermotility with retention) is due to this later supervening spasm.

A flattening in the longitudinal direction giving the cap an asymmetrical appearance is almost always localized on the medial side. It may be mere spasm of the longitudinal musculature, but is very often the result of organic changes. Such retraction when in the basal border gives the appearance of an eccentrically placed lumen of the pylorus.

The ulcer diverticulum is a pocket shaped projection of the wall of the duodenal cap. The mucous membrane is usually intact. Their site of predilection is in the ring shaped recess of the cap. They are of two types: The large and indefinitely defined, found in the lateral border, usually proximal to a spastic bulb defect, and the small circumscribed, found on the medial side immediately connected with the sphincter of the pylorus.

Traction diverticulum occurs very rarely.

In comparison with deformities of the duodenal cap shadows, changes in size, position, mobility, motility as well as sensitiveness to pressure, play a subordinate role in diagnosis of duodenal ulcer.

A marked diminution in size of the cap, unless some other deformity can be demonstrated, is to be considered as a generally shrunken cap.

Persisting opaque spots in the duodenal region, while they may be due to retention of barium in ulcer crater, are very often due to some recess or pocket formation without ulceration.

#### ABBSTRACTS AND REVIEWS

For different diagnostic purposes, the niche finding is pathognomonic. A spastic defect on the lateral and a retraction on the medial side is found exclusively in duodenal ulcer. In a marked eccentric wide open pylorus, it may be assumed with the greatest probability that it resulted from an ulcer. Also when there is a constant,

markedly pronounced, localized spasm on the greater curvature it may be assumed with the greatest probability that duodenal ulcer is present.

Deformity produced by gall-bladder conditions can be easily differentiated. They usually are very variable in different positions, and a normal cap can be demonstrated even when entire-

ly imbedded in adhesions. Pericholecystic adhesions show fine serrations, which often disappear when position is changed.

New growths such as papillomata or polyps give typical findings which are never confused with duodenal ulcer.

A. M. PFEFFER, M. D.

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## C O N T E N T S

The Cause of the Action of X-Rays and Gamma Rays of Radium Upon Living Cells 411 (Friedrich Dessauer, Ph.D.)	
Roentgenologic-Pathologic Conferences ..... 416 (Preston M. Hickey, M.D., and Aldred S. Warthin, M.D.)	
Diathermy—Its Field and Application..... 423 (Roland G. Breuer, M.D.)	
Gastro-Intestinal Foci of Infection in Chronic Deforming Arthritis—Radiological Study of a Series of Cases..... 426 (L. J. Carter, M.D.)	
Ultra-Violet Radiation in Malignancy..... 430 (A. J. Pacini, M.D.)	
Editorial ..... 434	
American College of Radiology and Physiotherapy.	
Necessity of Cooperation Between Radiologist and Physiotherapist and Surgeon.	
Dr. C. L. Mullins.	
Nobel Prize Awarded to Canadians.	
Case Reports..... 438	
Abstracts and Reviews..... 440	

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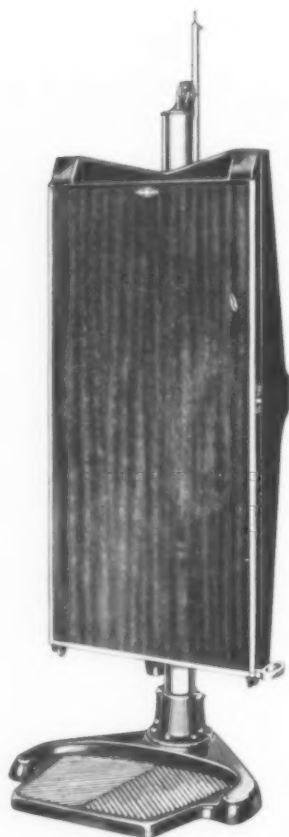


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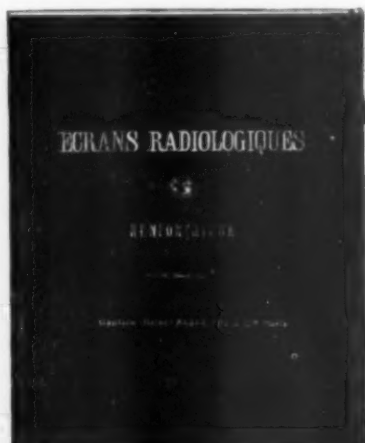
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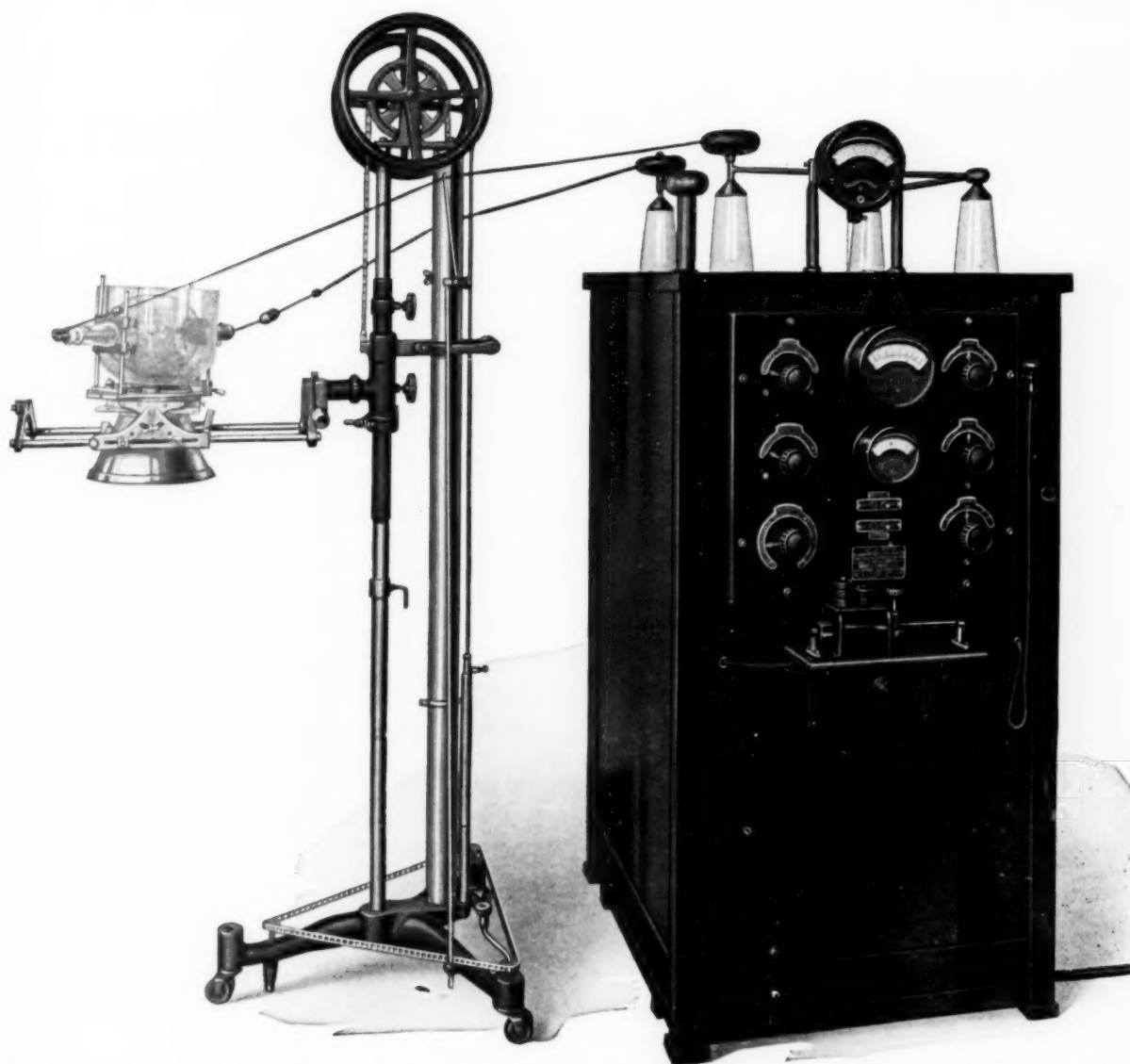
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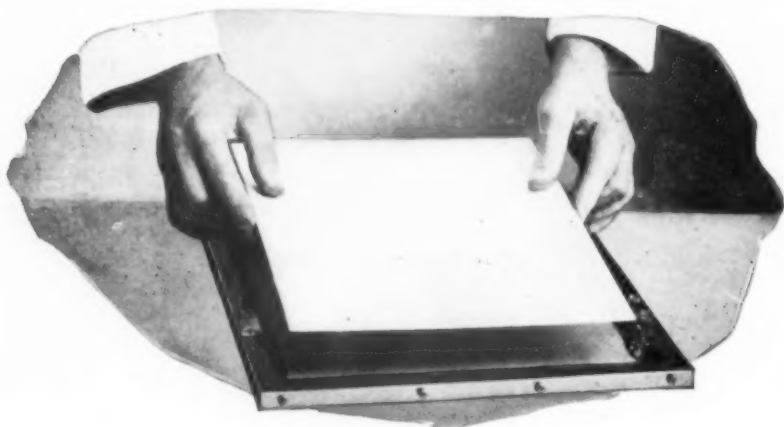


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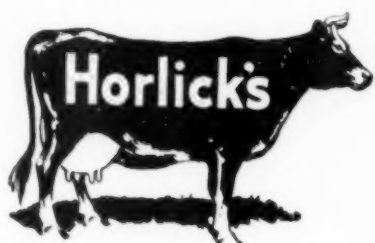
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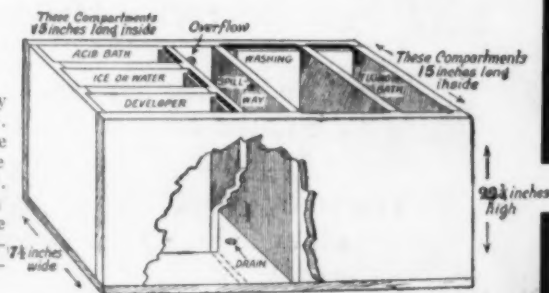
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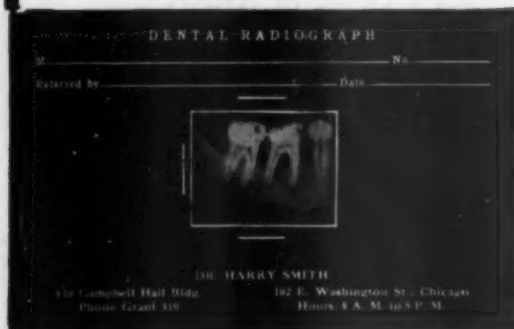


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